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SENSEMAKING OF NARRATIVES: INFORMING THE CAPABILITIES DEVELOPMENT PROCESS

by

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This capstone project determines whether sensemaking of soldier narratives can inform the Department of Defense's (DOD) capability development process (CDP). Sensemaking is the process of creating awareness and understanding in situations of high complexity or uncertainty. The authors gathered service member narratives concerning their use of fielded equipment, which created metadata for both quantitative and qualitative research and analysis. This capstone compares results from sensemaking of narratives with results from the Warfighter Technology Tradespace Methodology (WTTM), a system designed for the rapid fielding of equipment for small forward operating bases (FOBs) and combat outposts (COPs). The capstone finds that 1) soldier narratives inform the fielding process by providing an additional layer of meaning and context, and 2) soldier narratives do not replace current feedback mechanisms; rather, they play a complementary role. This capstone finds that narratives as a feedback mechanism can be applied during operational testing of newly developed or fielded equipment for the DOD's CDP.

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ABSTRACT

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LIST OF ACRONYMS AND ABBREVIATIONS

ACU	Army Combat Uniform
ART	Adaptive Red Team
ART/TSOA	Adaptive Red Team/Technical Support and Operational Analysis
ARSOF	Army Special Operations Forces
ATEC	Army Test and Evaluation Command
BFT	Blue Force Tracking
C2	command and control
CDP	Capability Development Process
COP	combat outpost
CORE	Common Operational Research Environment
COTS	commercial over the shelf
CROW	Common Remotely Operated Weapon
DFP TFT	Deployable Force Protection Technical Focus Team
DOD	Department of Defense
DOTMLPF	Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, and Facilities
DT	development test
FID	Foreign Internal Defense
FOA	Forward Operational Assessment
FOB	forward operating base
FSR	Field Service Representative
GBOSS	Ground Base Observation and Surveillance System
HTA	Hierarchical Task Analysis
IED	improvised explosive devices
IRB	Institutional Review Board
ITAS	Improved Target Acquisition System
LSA	Latent Semantic Analysis
LWS	Land Warrior System
MCoE	Maneuver Center of Excellence
MOS	military occupational specialty
MTOE	mission table of organization and equipment

OCP	Operation Enduring Freedom camouflage pattern
OPSEC	operational security
OT	operational testing
OTC	Operational Test Command
PM	program manager
RIP/TOA	Relief in Place/Transfer of Authority
S&T	science and technology
SENSI	sensemaking-experience-narrative-sensemaking-information
SME	subject matter expert
SVD	singular value decomposition
TEO	Test and Evaluation Office
TRADOC	Training and Doctrine Command
TSOA	Technical Support and Operational Analysis
UW	Unconventional Warfare
WTTM	Warfighter Technology Tradespace Methodology

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I. INTRODUCTION

A. BACKGROUND

Sensemaking of narratives as a feedback mechanism is rich with information and context that has the potential to advance the current development and fielding process of equipment. Historically, the feedback mechanism for developing and fielding equipment has been problematic in the United States (U.S.) Army. In the late 1800s, the U.S. Army employed special boards to evaluate, recommend, and field equipment on a large scale from clothing to arms,[1] which would eventually evolve into the capabilities development process (CDP).[2] Despite the CDP becoming the template for developing new equipment, not all equipment was suitable. For example, after the American Civil War between 1870 and 1880, footgear for infantry soldiers was poorly engineered yet still fielded.[3]

The feedback mechanism still experiences flaws in some of today's military equipment development and fielding process. In 1995, Douglas C. McChristian wrote, "The army struggled within its own bureaucracy to provide what it deemed best for its troops, whereas the soldiers themselves, seeking more practical solutions, exercised their initiative by obtaining what the army either over-looked or refused to issue."[4] A disconnect in information feedback exists between the U.S. Army decision makers and soldiers in regard to fielded equipment; the CDP is not maximizing the use of soldiers' experiences expressed as narratives[5] to gain useful information. McChristian's observations are still relevant.

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[1] Douglas C. McChristian, *The U.S. Army in the West, 1870–1880: Uniforms, Weapons, and Equipment* (Norman, OK: University of Oklahoma Press, 2006).

[2] The capabilities development process is the process for developing, testing, and fielding the most reliable and effective piece of equipment to enhance mission success. Defense Acquisition University, "Integrated Defense Acquisition, Technology, and Logistics Life Cycle Management System," June 15, 2010, https://ilc.dau.mil/pdf/ILC_hotspots_linked_pdf.pdf.

[3] McChristian, *The U.S. Army in the West, 1870–1880*.

[4] Ibid.

[5] Manfred Jahn defines narratives as "anything that tells or presents a story, be it by text, picture, performance, or a combination of these." Manfred Jahn, "Narratology: A Guide to the Theory of Narrative," *Narratology: A Guide to the Theory of Narrative*, May 28, 2005, http://www.uni-koeln.de/~ame02/pppn.htm#N2.

Although soldiers use narratives to share their experiences about problematic fielded equipment, such as the Army Combat Uniform (ACU), and the Land Warrior System (LWS), U.S. Army decision makers have not effectively analyzed these narratives to capture their rich information. The ACU, developed in 2003, and fielded in 2005, provided inadequate camouflage pattern for most combat environment.[6] In 2007, Eric Coulson, a U.S. Army officer, stated, "Considering all the testing the uniform went through, it is surprising such a mediocre product finally emerged…and I am not alone. I've talked to many soldiers that have had this happen."[7] Four years after fielding, the U.S. Congress finally acknowledged the issues with the ACU and directed the development and fielding of the Operation Enduring Freedom camouflage pattern (OCP) in 2009.[8] However, this uniform only applied to units deploying to Afghanistan, which did not fix the ACU issue for the entire U.S. Army. As of 2014, no official decision has been made to replace the ACU.[9]

In 1994, the U.S. Army began developing the LWS.[10] The LWS was a digital integrated fighting system for individual infantry soldiers intended to give them enhanced tactical awareness, lethality, and survivability.[11] Soldiers stated that the LWS did not perform these functions. In 2005, a Department of Defense (DOD) report showed that soldiers criticized the LWS for "excessive weight, poor communication and a number of human factors concerns."[12] In 2009, Sergeant James Young stated that the LWS was "a

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[6] GAO.gov, "Warfighter Support: DOD Should Improve Development of Camouflage Uniforms and Enhance Collaboration Among the Services," September 28, 2012, http://www.gao.gov/products/GAO-12-707.

[7] Eric Coulson, "New Army Uniform Doesn't Measure Up," *Military.com,* April 5, 2007, http://www.military.com/NewsContent/0,13319,131103,00.html.

[8] GAO.gov, "Warfighter Support: DOD Should Improve Development of Camouflage Uniforms and Enhance Collaboration Among the Services."

[9] Washington Post, "The U.S. Military's Changing Camouflage," accessed February 21, 2014, http://apps.washingtonpost.com/g/page/politics/the-us-militarys-changing-camouflage/140/.

[10] Army-Technology.com, "Land Warrior Integrated Soldier System—Army Technology," accessed February 21, 2014, http://www.army-technology.com/projects/land_warrior/.

[11] Army-Technology.com, "Land Warrior Integrated Soldier System—Army Technology." The systems integrated into Land Warrior are the weapon system, helmet, computer, digital and voice communications, positional and navigation system, protective clothing and individual equipment.

[12] Sandra Erwin, "Army 'Land Warrior' Not Yet Ready for War, Gears Up for Next Tryout," *NDIA,* March 2006, http://www.nationaldefensemagazine.org/archive/2006/March/Pages/land_warrior3037.aspx.

bunch of stuff we don't use, taking the place of useful stuff like guns…It makes you a slower, heavier target."[13] Based on soldier narratives, the U.S. Army unsuccessfully attempted to trim down the system, eventually canceling the program a decade later, without it ever being fielded.[14]

These two examples show that narratives can provide powerful information. However, decision makers need to understand how to make sense of the narrative to access such information. One process for gathering and analyzing this information is known as sensemaking. Sensemaking is the process of creating awareness and understanding in situations of high complexity or uncertainty to make decisions.[15]

B. PURPOSE AND SCOPE

Research has identified that a relationship exists between sensemaking and the ability to understand and derive meaning from narratives.[16] The purpose of this research is to determine whether sensemaking of narratives can inform the Army CDP. Specifically, the scope of this research analyzes narratives using the sensemaking process to inform development and fielding decisions. This research refers to the sensemaking process and the narrative in a broad sense to understand information.[17] Narratives and stories are terms used synonymously throughout this study. This research does not analyze how individuals use sensemaking to create narratives from experiences. Furthermore, this research compares information gained on the ground-based observation and surveillance system (GBOSS) using two different assessment methods.

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[13] Noah Shachtman, "The Army's New Land Warrior Gear: Why Soldiers Don't Like It," *Popular Mechanics*, October 1, 2009, http://www.popularmechanics.com/technology/military/4215715.

[14] Defense Industry Daily, "Slimmer, Trimmer U.S. Army Land Warrior System Moves Ahead," *Defense Industry Daily*, September 26, 2010, http://www.defenseindustrydaily.com/Slimmer-Trimmer-US-Army-Land-Warrior-System-Moves-Ahead-05890/.

[15] David Snowden, "What Is Sense-Making?—Cognitive Edge Network Blog," *Cognitive Edge Network*, June 7, 2008, http://cognitive-edge.com/blog/entry/3840/what-is-sense-making/.

[16] Andrew D. Brown, Patrick Stacey, and Joe Nandhakumar, "Making Sense of Sensemaking Narratives," *Human Relations* 61, no. 8 (2008): 1035–62.

[17] Zhang et al. refers to broad sense of sensemaking as the total process of (1) searching for information and (2) making sense of information. Pengyi Zhang et al., "Extending Sense-Making Models with Ideas from Cognition and Learning Theories," *Proceedings of the American Society for Information Science and Technology* 45, no. 1 (2008): 23–23.

C. SUMMARY OF FINDINGS

This research determined that sensemaking of narratives can inform the CDP. Analysis of service member narratives provided similar qualitative information that aligned with current feedback methodologies assessing fielded equipment. Service member narratives do not replace current feedback mechanisms, but rather they play complementary role.

D. CHAPTER OVERVIEW

Chapter II describes sensemaking and narrative theories in the context that they apply to this research. Chapter III illustrates the U.S. Army Capabilities Development Process (CDP) and the Warfighter Technology Tradespace Methodology (WTTM). Chapter IV describes the methodology of the research with descriptions and explanations of the research test subjects, the collection tool (SenseMaker Collector), and the analysis tool (SenseMaker Explorer). Chapter V provides the research findings to determine if sensemaking of narratives informs. Finally, Chapter VI explores the potential use of sensemaking in other facets of the DOD.

II. THEORETICAL FRAMEWORK

This chapter introduces a researcher-developed model to describe the relationship between the narrative and sensemaking theories. Additionally, the model is explained in two separate processes to show how individual experiences are transformed into information.

A. CREATING NARRATIVES THROUGH SENSEMAKING

In this research, sensemaking is used in two contexts in relation to the narrative. First, individuals make sense of their experiences to create narratives; second, researchers then make sense of these narratives to gain information. The second context is the focus of this research. This relationship is depicted in the sensemaking-experience-narrative-sensemaking-information (SENSI) model shown in Figure 1.

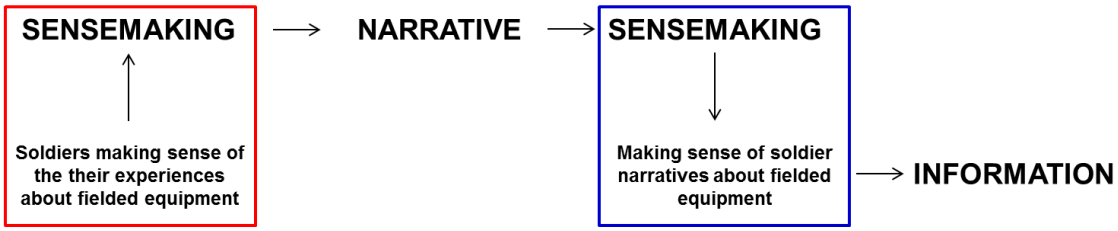

Figure 1. SENSI model: Making sense of experiences and narratives

Humans communicate through oral or written stories to influence, capture events, and understand and express simple and complex ideas. Storytelling is a uniting and defining component of all communities.[18] Stories have empowered social movements by providing context of shared experiences. According to Polletta, activists in social movements use storytelling to mobilize people and gain popular support.[19] Human

[18] David Snowden, "Story Telling: An Old Skill in a New Context," *Business Information Review* 16, no. 1 (1999): 30–37.

[19] Francesca Polletta, "Culture and Movements," *The Annals of the American Academy of Political and Social Science* 619, no. 1 (2008): 78–96.

communication through storytelling is possible because of common languages, which are associated to meanings.[20]

The transfer of knowledge and learning is the fundamental mechanism of the narrative.[21] Walter R. Fischer's narrative paradigm makes it possible to assume that stories are the basic form of human communication. The narrative paradigm states that human communication should be viewed as historical, as well as situational, as stories competing with other stories constituted by good reasons, as being rational when they satisfy the demands of narrative probability and narrative fidelity, and as moral inducements.[22] Fisher claims that humans communicate through storytelling, and that they make sense of their experiences through personal narratives. Fisher's claim, in other words, addresses the first context of sensemaking in the SENSI model.

Sensemaking in the first context of the SENSI model is a method in which humans integrate experiences into distinct stories or narratives. Karl Weick states:

> The role of stories in sensemaking has been given considerable attention recently, due in part to Mitroff and Kilmann's (1976) pilot study, Fisher's (1984) systematic thinking, Polkinghorne's (1988) survey, and Bruner's (1990) and Zukier's (1986) engaging discussions of the idea that people think narratively rather than argumentatively or paradigmatically.[23]

Weick highlights the relationship and importance that narratives have in sensemaking. When one individual or a group of people shares their story or narrative, people interprets or makes sense of the information in their own way and from their own viewpoint and familiarities. To understand this phenomenon of narratives, an entire discipline was created in academia called narratology.

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[20] Dan Sperber, "How Do We Communicate," *How Things Are: A Science Toolkit for the Mind*, 1995, 191–99.

[21] Snowden, "Story Telling."

[22] Walter R. Fisher, "Narration as a Human Communication Paradigm: The Case of Public Moral Argument," *Communications Monographs* 51, no. 1 (1984): 1–22.

[23] Karl E. Weick, Kathleen M. Sutcliffe, and David Obstfeld, "Organizing and the Process of Sensemaking," *Organization Science* 16, no. 4 (2005): 409–21.

Narrative theory is a humanities discipline dedicated to the study of the logic, principles, and practices of narrative representation.[24] Tzvetan Todorov first formally introduced this discipline in 1969 by proposing "a new type of generalizing theory that could be applied to all domains of narrative."[25] However, Todorov's initial definition of narratology has evolved over time as captured by Jan Meister. Meister states:

> During its initial or "classical" phase, from the mid-1960s to the early 1980s, narratologists were particularly interested in identifying and defining narrative universals. This tendency is still echoed in a concise 1993 definition of narratology as "the set of general statements on narrative genres, on the systematics of narrating (telling a story) and on the structure of plot" (Ryan & von Alphen 1993: 110).

However, a decade later, narratology was alternatively described as (a) "a theory (Prince 2003, 1), (b) a method (Kindt & Müller 2003, 211), or (c) a discipline (Fludernik & Margolin 2004, 149)."[26]

All three definitions of narratology from the mid-1960s to the present are based upon the same principle, narratives identify meaning through experiences. Narratives provide meaning across a wide range of disciplines, particularly from the fields of social sciences, such as anthropology and folklore, psychology, sociology, law, medicine, nursing, and social work.[27] Narratives are powerful tools to assist in decision making because they provide information and context to problems or situations.

B. UNDERSTANDING NARRATIVES THROUGH SENSEMAKING

How can narratives be captured and analyzed to understand their meaning to gain information? Sensemaking makes it possible to take a complex problem or idea and

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[24] Inderjeet Mani, "Revision of Computational Narratology from Wed, 26. June 2013," *The Living Handbook of Narratology*, January 28, 2013, http://www.lhn.uni-hamburg.de/node/43/revisions/128/view.

[25] Christopher Meister, "Narratology," *The Living Handbook of Narratology*, August 26, 2011, http://www.lhn.uni-hamburg.de/article/narratology.

[26] Ibid. Jan Meister is a professor of Narratology at the University of Hamburg, Germany.

[27] Lewis P. Hinchman and Sandra K. Hinchman, *Memory, Identity, Community: The Idea of Narrative in the Human Sciences* (Albany, NY: SUNY Press, 1997).

understand its meaning in a simplified way that is understandable and makes sense.[28] This concept is the second context of sensemaking in the SENSI model. This research uses sensemaking to deconstruct narratives through pattern and narrative analyses.

Pattern analysis evaluates information through conceptual grouping, organized by themes, to gain an in-depth understanding of the experience of particular individuals. Narrative analysis ranges from analyzing verbal and non-verbal quantitative or qualitative data.[29] Sensemaking, through pattern and narrative analyses, has the ability to extract information embedded within narratives. This information is predominantly qualitative and provides access to subjective experiences and insights. The extracted information from the narratives is the final product of the SENSI model.

This research acknowledges that the sensemaking process has been practiced in many disciplines and fields of study. Several examples are in the fields of communications,[30] business,[31] social sciences,[32] and the military, specifically in command and control (C2),[33] decision making,[34] and intelligence analysis.[35]

Sensemaking of narratives is a powerful tool to understand experiences and ideas, which provides contextual meaning and insight. Narrative and sensemaking theories have

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[28] Gary Klein, Brian M. Moon, and Robert R. Hoffman, "Making Sense of Sensemaking 1: Alternative Perspectives," *IEEE Intelligent Systems* 21, no. 4 (2006): 70–73.

[29] Catherine Kohler Riessman, "1 Narrative Analysis," 2005, http://cmsu2.ucmo.edu/public/classes/Baker%20COMM%205820/narrative%20analysis.riessman.pdf.

[30] Alan H. Schoenfeld, "Learning to Think Mathematically: Problem Solving, Metacognition, and Sense Making in Mathematics," *Handbook of Research on Mathematics Teaching and Learning*, 1992, 334–70.

[31] Arch G. Woodside, "Sensemaking about Business-to-Business Strategies and Relationships: A Commentary on Reid and Plank's Review," *Journal of Business-to-Business Marketing* 7, no. 4 (2000): 45–53.

[32] Joyce S. Osland and Allan Bird, "Beyond Sophisticated Stereotyping: Cultural Sensemaking in Context," *The Academy of Management Executive* 14, no. 1 (2000): 65–77.

[33] Eva Jensen, "Sensemaking in Military Planning: A Methodological Study of Command Teams," *Cognition, Technology & Work* 11, no. 2 (2009): 103–18.

[34] S. G. McIntyre, Marlene Gauvin, and Barbara Waruszynski, "Knowledge Management in the Military Context," *Canadian Military Journal* 4, no. 1 (2003): 35–40.

[35] Peter Pirolli and Stuart Card, "The Sensemaking Process and Leverage Points for Analyst Technology as Identified through Cognitive Task Analysis," in *Proceedings of International Conference on Intelligence Analysis*, vol. 5, 2005, 2–4.

been successfully applied to various disciplines and have the potential application to the Army's CDP. The ability to deconstruct narratives through sensemaking to obtain a deeper understanding could have the potential to inform current and future equipment development processes, bridging the gap between decision makers and warfighters.

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III. DEVELOPMENT AND ASSESSMENT PROCESSES

This chapter provides an overview of the DOD'S CDP and the WTTM. This research also identifies possible areas within these two processes in which narratives could be employed to gain service member feedback on fielded equipment.

A. CAPABILITIES DEVELOPMENT PROCESS

This process is a component of the integrated defense acquisition, technology, and logistics life cycle management system that provides service members with the most reliable and effective piece of equipment to enhance mission success.[36] The CDP is divided into five phases: material solution analysis phase, technology development phase, engineering and manufacturing development phase, production and deployment phase, and operations and support phase (see Appendix A, Integrated Defense Acquisition, Technology, and Logistics Management Life Cycle).[37] Although specific in each function, and well delineated, phases blend together to maximize integration and momentum in transitioning from one phase to the other. The ultimate goal is a support program that meets material readiness and operational support performance requirements and sustains a system in most cost-effective manner.[38]

The initiating step in the CDP is defining the customer's requirements of a piece of equipment. Customers range from Combatant Command hierarchies, Army-level staff initiatives, DOD programs, Congressional mandates and service members. Annotation and delivery of a customer's needs or requirements is executed through operational need statements, think tanks, or higher authority directives. This process creates several levels of separation from the originator to the developer. The combat developer and the Army

[36] The Under Secretary of Defense for Acquisition, Technology, and Logistics provides oversight and management of the CPD through each service component's Office of the Assistant Secretary for Acquisition, Logistics, and Technology. OSD.ATL-Webmaster@mail.mil, Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, "Welcome to AT&L," accessed March 31, 2014, http://www.acq.osd.mil/.

[37] Defense Acquisition University, "Integrated Defense Acquisition, Technology, and Logistics Life Cycle Management System."

[38] Ibid.

J3/5/7 Joint Staff (strategic operations, force, and policy development) must then determine the functions of the system and what decision makers value through stakeholder, functional, and value modeling analysis. Specifically, they define and validate the requirement in the form of Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, and Facilities (DOTMLPF).[39]

Once the DOTMLPF is revised and refined, based on the needs, wants, and desires of the customer, the requirement document is tasked to the Acquisition Corps, specifically, a material developer for initiation of phase one of the CDP, the material solution analysis phase. A material developer must dissect the requirement to allow the ability to employ the most subordinate and intermediate cost effective material solutions per entity of the requirement. A material developer has the option to select commercial over the shelf (COTS) and army supply system materials from any range of companies. If unable to use either of these solutions, or only able to utilize in support of select entities of the requirement, the material manager can build a technology development contract with an accredited company.[40] The final output of the first phase is a product support strategy that encompasses a fully defined requirement, architectural solution, concept of operational equipment development, and adequate allocated funds in support of further development. As previously mentioned, the initiation of the technology development phase begins upon finalization of the architectural solution, but phase 1 does not end until all required materials for the solution are accounted for physically or contractually.

During the second phase, technology development, the material developer works with and manages the contracted companies tasked to synchronize materials solutions with technological advances and develop initial prototypes. Development of initial prototypes provides a litmus test and azimuth check for the material and combat developer, as well as for army staff to validate that the pre-defined architectural solution and concept of the operational equipment's development are in line with the customer requirements and production rate. The initial prototype is validated through testing

[39] Chairman of the Joint Chief of Staff, *Joint Capabilities Integration and Development System*, Joint Chief of Staff Instruction, January 10, 2012.

[40] Defense Acquisition University, "Integrated Defense Acquisition, Technology, and Logistics Life Cycle Management System."

functional and enabling specifications, as thoroughly defined from the customer's requirement. The validation of the overall system's performance triggers the evolutionary acquisition strategy, which includes full level accreditation of the strategy by the Army staff and the DOD. The prototype is then transitioned to a program manager (PM) to proceed with increased production of the prototype and to build the engineering and manufacturing contract, which is the start of the engineering and manufacturing development phase and end of phase 2.[41]

Within the third phase, engineering and manufacturing development, the PM transitions from a solicitor and manager to strictly a manager, who manages the prototype or equipment production rate throughout the longest phase of the CDP. The main priority during this phase is meeting the initial product baseline with all prototypes in compliance with the validated performance functions, prescribed system threat assessment, and sustainment management requirement. Once the evolution of a product baseline is reached, the first systems engineering test and validation supportability program, also referred to as the development test (DT), is initiated through Department of the Army accredited test boards, civilian organizations, and military units. The goal of the test program is to use the equipment in scripted simulated military situations in which the equipment will ideally be utilized in the future in support of assigned missions, combat or training. The end result of the test program is a conceptual and thorough report, which states that the prototype or equipment meets all the prescribed functional requirements and specifications, is durable, and meets the safety requirements defined by the DOD. The positive test report grants the PM the certification to submit to the Army Staff and the DOD a request for mass production of the equipment (no longer a prototype) and initiate the final evolutionary acquisition strategy.[42]

The initial manufacturing rate in the final two phases, production and deployment as well as operations and support, begins at a low rate baseline to allow for a final test phase and an opportunity for final adjustments and corrective actions to provide the best

[41] Defense Acquisition University, "Integrated Defense Acquisition, Technology, and Logistics Life Cycle Management System."

[42] Ibid.

material solution for the customer. The PM can conduct an operational testing (OT) on the equipment, which includes a non-scripted test by an operational Army unit during training exercises. The current feedback and report produced from this test program is not defined in a prescribed or mandated document; it is simply at the control or preference of the PM. Upon conclusion of the final test program and address of any adjustments or modifications needed, the PM moves to final validation by the Army J3/5/7 and combat developer to gain the approval to initiate the fielding phase. The initial equipment fielding phase includes a small baseline of the equipment fielded to selected units for testing in either a training or combat environment. During this phase, the soldiers of the receiving units participate in training on the operational employment and sustainment of the fielded equipment, and may be permanently tasked a field service representative (FSR) for depot level maintenance or technological issues.[43]

Following the initial fielding phase, the PM has an option to gain feedback from operational units or assessment organizations on the performance, durability, and overall function of the equipment to acquire qualitative data for any modifications or adjustments. Examples of assessment organizations are the Forward Operational Assessment teams (FOA)[44] and the Maneuver Center of Excellence (MCoE). The FOA's feedback mechanism includes surveys and interviews to gain information on equipment being used in operational settings. The collected soldier feedbacks are used to generate a report called the forward operational assessment report for Army leadership and capabilities developers to inform the CDP.[45] MCoE's feedback mechanisms include surveys comprised of Likert Scales, multiple choices, and opened ended questions to ask soldiers to rate the effectiveness or importance of U.S. Army systems (equipment and

[43] John Bryan, PEO soldier interview, October 28, 2013.

[44] The Forward Operational Assessment (FOA) teams are subordinate to the Operational Testing Center (OTC) within The United States Army Test and Evaluation Command (ATEC). Shane Dietrich, *Wartime Test and Evaluation; Initiatives Lead to Cultural Change* (research paper, Carlisle Barracks, PA: U.S. Army War College, 2007).

[45] David Taylor, "Forward Operational Assessment Team Survey (Long Version)," *DVIDS*, accessed November 21, 2013, http://www.dvidshub.net/video/302960/forward-operational-assessment-team-survey-long-version.

training).[46] Similar to the operational testing program, utilizing these feedback mechanisms are neither mandated nor even executed by all PMs. Once the initial fielding phase is complete, and the identified initial baseline of equipment is fielded, the PM moves to high-rate baseline production and fielding.

High-rate fielding is the final step in the CDP. It is the point in the phase at which mass production of the equipment is complete and all equipment is fielded to the selected units in accordance with the prescribed army mission table of organization and equipment (MTOE). If any additional issues or requirements surface during this stage, the PM has limited options to address these issues or requirements. If the PM's program has sufficient funds to support a modification, the material developer creates a modification document approved by the combat developer, and then executed by the equipment developer under the guidance of the PM. If the PM's program does not have sufficient funds, then the PM has a choice of either working with the combat developer to create possibly a new requirement or to do nothing at all. If the issue does not fall within the initial requirement for the equipment, then a new requirement must be created and approved by the Army J3/5/7 and combat developer. At this point, the CDP is reinitiated from the initial phase.[47]

B. MANEUVER CENTER OF EXCELLENCE: THE SOLDIER SURVEY

The Test and Evaluation Office (TEO) within the MCoE at Fort Benning, Georgia uses a comprehensive survey called The Soldier Survey to gather data from recently redeployed soldiers on equipment and training.[48] The Soldier Survey, formally known as the Post-Combat Survey, has been in use within the U.S. Army since 2003 with 18,000 soldiers participating to date. The MCoE initiative, which is "designed to assess current field support, recommend improvements, and inform future modernization efforts across DOTMLPF," allows soldiers to provide feedback on equipment and training that is and is

[46] Test & Evaluation Office, "The Soldier Survey Information Brochure" (Fort Benning, GA: Maneuver Center of Excellence, 2012), http://www.benning.army.mil/Library/content/TheSoldier SurveyInformationBrochure.pdf.

[47] Bryan, PEO soldier interview.

[48] Test & Evaluation Office, "The Soldier Survey Information Brochure."

not working.[49] These feedbacks are intended to assist the senior U.S. Army leadership and PMs in making procurement or modification decisions within the CDP.

The Soldier Survey process starts with requirements as outlined by MCoE, PMs, U.S. Army Training and Doctrine Command (TRADOC), and U.S. Army staff. These requirements focus on system improvements, materiel development, future modernization, and prioritization.[50] The TEO refines the requirements into questions and administers the surveys to soldiers using laptops in a classroom setting during unit "lessons learned weeks." The data collected is then analyzed and compiled into a report called The Soldier Survey Report. The process is intended to be cyclical with new requirements being derived from the reports.

The format of The Soldier Survey uses Likert Scales, multiple choices, and opened ended questions to ask soldiers to rate the effectiveness or importance of U.S. Army systems (equipment and training).[51] The survey does not focus on a single or common themed system, but rather covers a large variety of systems that include mounted systems, clothing items, weapon systems, munitions, optics, and sustainment items, as well as training and combat operations.[52] The output of The Soldier Survey provides both quantitative and qualitative analysis of the data with a heavy focus on percentage breakdowns of soldier responses, e.g., effectiveness of weapons systems, comfort of clothing items, and usefulness of particular training. The output also includes bulleted comments from the open-ended questions that highlight the quantitative analysis.

Through a multi-system approach, The Soldier Survey has been able to cover a large field of requirements in a short amount of time for the benefit of the U.S. Army senior leadership and decision makers. The Soldier Survey cycle, methodology, and content has resulted in significant improvements with various systems, such as the OCP

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[49] Test & Evaluation Office, "The Soldier Survey Information Brochure."

[50] Ibid.

[51] Ibid.

[52] Test & Evaluation Office, *The Soldier Survey Report* (Fort Benning, GA: Maneuver Center of Excellence, 2013).

uniforms, soldier plate carrier system, ground combat vehicle, and the individual carbine.[53]

C. WARFIGHTER TECHNOLOGY TRADESPACE METHODOLOGY

Within the DOD, the PM executes operational assessments through the Operational Test Command (OTC) to inform the CDP process.[54] Operational tests are not only conducted by DOD organizations, they are also conducted by independent organizations, one of which is known as the Adaptive Red Team (ART). ART conducts operational assessments at Technical Support and Operational Analysis (TSOA), which includes both government and industry member participations. ART/TSOA uncovers field performance and usability, as well as system vulnerabilities.

ART/TSOA works with and informs industry, academia, and government laboratories to address innovative technologies and capabilities for the warfighter.[55] ART/TSOA identifies candidate technology solutions, informs future science and technology (S&T) investments, and generates insights into technology robustness and product improvement through scenario-driven exercises, soldier involvement, and assessment guided by the WTTM.

WTTM is the academic underpinning of TSOA. Its uses practices, tools, and techniques gained from systems engineering, logistics and human systems integration, and modeling and simulation to support quantitative and qualitative assessments to identify new system vulnerabilities and risks. WTTM gains feedback on equipment by focusing on three primary domains: logistics, user, and technology. WTTM applies three mechanisms to gain feedback: the ART/TSOA WTTM Assessment Tool, the Hierarchical Task Analysis (HTA), and informal dialogues between evaluators, service

[53] Test & Evaluation Office, "The Soldier Survey Information Brochure."

[54] Operational Test Command is responsible for planning, conducting, and reporting operational tests, assessments, and experiments on military equipment. OTC is a subordinate command within the Army Test and Evaluation Command (ATEC). U.S. Army Operational Test Command, "United States Army Operational Test Command," February 28, 2014, http://www.otc.army.mil/.

[55] Adaptive Red Team, "2014-RFI for Adaptive Red Team/Technical Support Operational Analysis (ART/TSOA) Activity Supporting the Deployable Force Protection Technical Focus Team (DFP TFT)—2014-RFI-ART-TSOA (Archived)—Federal Business Opportunities," *FBO.gov*, October 13, 2013.

members, and equipment developers. The ART/TSOA WTTM Assessment Tool (see Appendix B, Example of the ART/TSOA Assessment Tool (WTTM Logistic Factors)) uses numerical scales to evaluate equipment performance (see Figure 2). The Hierarchical Task Analysis[56] (see Appendix C, Example of Hierarchical Task Assessment for Centurion Multi-Mission System [CMMS]) assesses the completion time of specified tasks by either expert, trained, or untrained individuals. Informal dialogues are used to gain evaluators, service members, and equipment developers' personal experiences with assessed equipment. Lastly, all three feedbacks mechanisms collect commentaries from evaluators, service members, and equipment developers.

WTTM User Factors						
Factor 1: Training Burden (UB)						
Type of Trainer Required	**Geographic Location of Required Training**	**Required Time to Train**	**Notes & Comments**	**EL**	**ML**	**EH**
None	No training required	0	Some systems can have training installed in parallel with its command and control so that an end user can switch to this mode as needed. The chances of this asset getting lost, damaged, or destroyed is less than if it is shipped with the system.	10	10	10
Imbedded on System	Location doesn't matter	less than 1 hour		9	9	9
Shipped with System (e.g., DVD)		1 - 2 hours		8	8	8
	On site where the system is installed and operational	2 - 4 hours		7	7	7
Military trainer from within unit		4 - 6 hours		6	6	6
		6 - 12 hours		5	5	5
Military trainer from outside unit	At the next higher unit's location	12 - 24 hours		4	4	4
		1 - 2 days		3	3	3
Field Service Representative Only	CONUS military facilities only	3 - 5 days		2	2	2
	CONUS developer site(s) only	more than a week		1	1	1

Figure 2. An example of the ART/TSOA WTTM assessment tool assessing the domain of user factors

Through TSOA events, WTTM has been successful in improving many systems. Highlights include recommendations that reduced the size, weight, and power of a radar system, reduced system vulnerabilities through encrypted integration into situational awareness software, reduced user training requirements through better interface design and appearance, as well as the addition of help videos, decreased system decision time via suggested changes to user interface, increased training effectiveness by suggesting better organization and design of soldier training devices, etc.

[56] Hierarchical Task Analysis (HTA) is a process of developing a description of a task in terms of operations—things which people do to attain goals—and plans—statement of conditions when each of a set of operations has to be carried out to attain an operational goal. Barry Kirwan and Les K. Ainsworth, *A Guide to Task Analysis: The Task Analysis Working Group* (Boca Raton, FL: CRC Press, 2003)

WTTM parallels the CDP, specifically, the operational assessment within the production and deployment phase (see Figure 3). Currently, in phase 4, the PM uses the OTC to conduct operational assessment of new equipment.[57] Similarly, ART/TSOA provides a comprehensive and validated option to the equipment developer to conduct operational assessment using WTTM, which poses the question, "Can sensemaking of service member narratives as a feedback mechanism during operational assessments provide useful information and insights for the equipment developers and PMs?" Given the parallel relationship between the CDP and WTTM, sensemaking of narratives offers another approach for assessing equipment, as well as the development process itself.

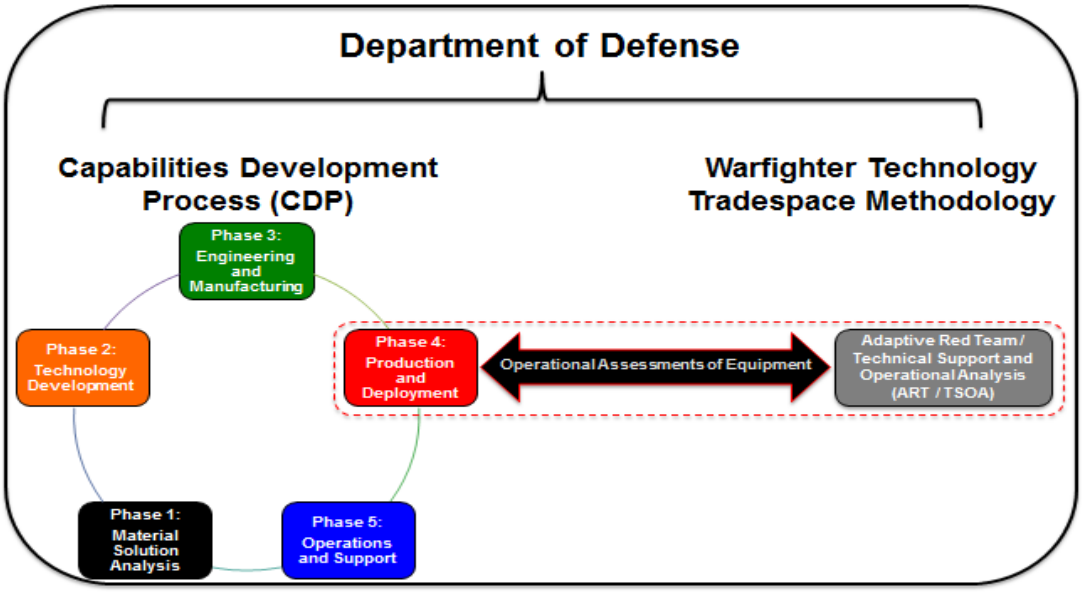

Figure 3. Implementation of Operational Assessment of Equipment during Phase 4 of the CDP and during the ART/TSOA of WTTM

[57] U.S. Army Operational Test Command, "United States Army Operational Test Command."

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IV. METHODOLOGY

This chapter provides the method by which this research is conducted, a detailed description of the collection instrument used to collect service member narratives, and the computer software used to analyze those narratives.

A. PARTICIPANTS

The test subjects for this research consists of U.S. Army (269 subjects) and Marine Corps (10 subjects) service members from three separate battalions. Two U.S. Army infantry battalions and one U.S. Marine Corps battalion were selected based on their availability within the rest-training-deployment cycle. Service members were selected based on purposive random sampling of each battalion's demographic; they were included in the sample test subjects because of their "specialist knowledge of the research issue," which is the use of military equipment.[58] The data collection was conducted on three separate occasions in three different locations from May to December 2013.

No discriminating factors were used to disqualify the test subjects from participating in the research (e.g., education levels, experiences in the military, or MOS). As long as the test subjects were part of the units sampled and were willing to volunteer, they were free to participate. Similarly, the test subjects were informed that they could discontinue their participation at any time, even after they had provided their input. No service members discontinued their participation.

To protect the test subjects' privacy, all data collected from the service members were reviewed for any personal information in accordance with the Naval Postgraduate School Institutional Review Board (IRB) protocol. Additionally, any information

[58] Purposive random sampling is defined as a form of non-probability sampling in which decisions concerning the individuals to be included in the sample are taken by the researcher, based upon a variety of criteria that may include specialist knowledge of the research issue, or capacity and willingness to participate in the research. Paul Oliver and Victor Jupp, "Purposive Sampling," 2006, http://eprints.hud.ac.uk/id/eprint/2049.

identifying specific unit, location, and mission was removed in accordance with the DOD operational security (OPSEC) policy to prevent leakage of sensitive information.[59]

B. COLLECTION AND ANALYSIS PROCESS

We administered a collection instrument using a PowerPoint template (see Appendix D, PowerPoint Collection Tool Administered To Gather Service Member Narratives) that mirrored the SenseMaker[60] Collector, which was comprised of a narrative prompt, Triads, and Dyads.[61] We then transferred the PowerPoint collected data into the SenseMaker Collector using 12 computers in a controlled environment to capture narratives and their signifiers. We provided the service members a brief introduction to the purpose of the research and the collection instrument. At the beginning of the collection instrument, service members received a narrative prompt (see Figure 4) that invoked emotions to elicit personal experiences with equipment. Service members were not limited to answering all or any of the questions presented in the narrative prompt. Service members then created their narratives by making sense of their experiences about equipment.

[59] Department of Defense, *DOD Operations Security (OPSEC) Program: DOD Directive 5205.02E*, Department of Defense, June 20, 2012.

[60] SenseMaker® is a pattern and visual analysis tool that utilizes both hard (numbers/facts) and soft (opinions/feelings) data for examination. David Snowden and Steven Bealing, *Computer-Aided Methods and Systems for Pattern-Based Cognition from Fragmented Material*, October 4, 2011.

[61] A Triad is a three-dimensional signifier designed to amplify a respondent's narrative; a Dyad or a linear scale signifier, is a polarity scale that amplifies a respondent's narrative. "Introducing SenseMaker®," video clip, YouTube, 2009, http://www.youtube.com/watch?v=SkRe7Xg7pk4& feature=youtube_gdata_player.

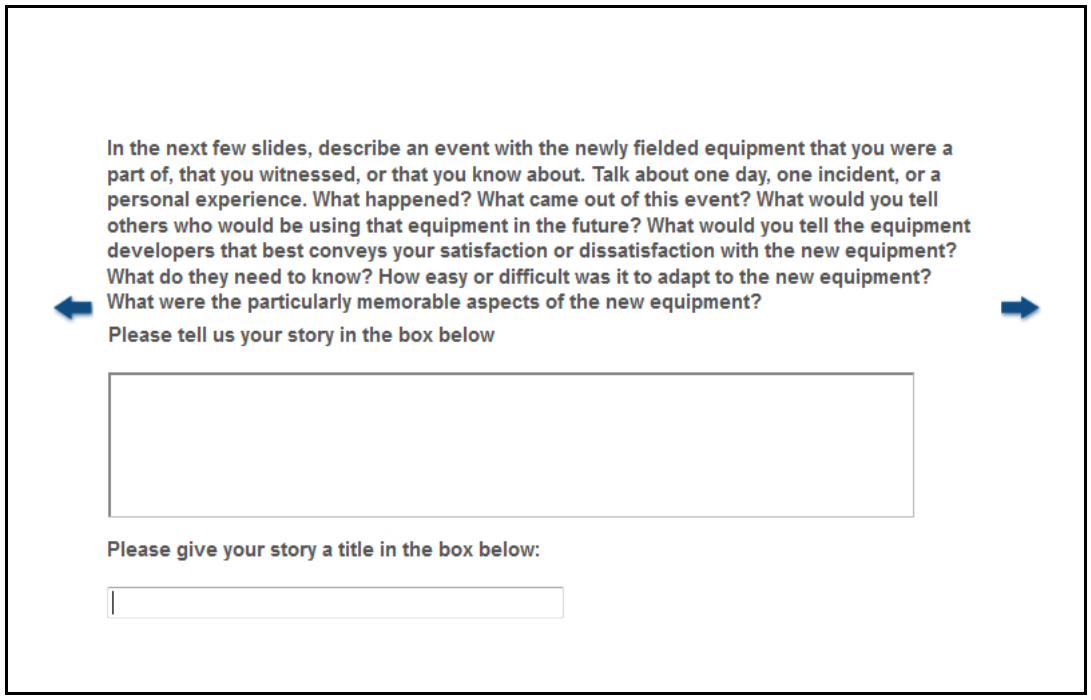

Figure 4. Prompt administered to service members to collect their narratives

Upon completion of the narrative portion, service members completed a series of nine Triads to amplify their narratives. Each Triad is comprised of a specific prompt based on a theme, such as "improve" (see Appendix E, Eight Triad Themes, Prompts, and Signifiers), and three signifiers. Service members positioned a dot within the Triad that linked the relationship between the three signifiers and their narrative. If no relationship existed, then service members selected the "N/A" option (see Figure 5). Triads provided context to the service member narratives to allow a deeper understanding of their experiences. Additionally, Triads allowed the service members the ability to reinforce certain ideas and experiences within their narrative.[62]

[62] "Introducing SenseMaker®."

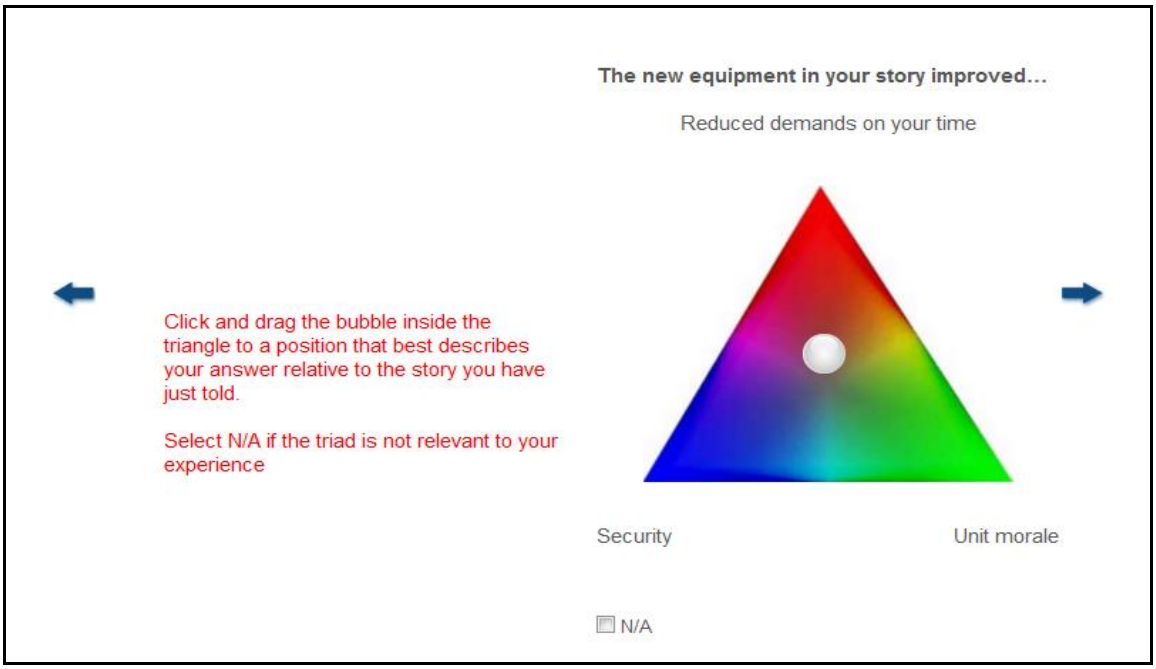

Figure 5. An example of a SenseMaker Collector Triad based on the theme of "Improve" with the prompt "The new equipment in your story improved"

In a manner similar to Triads, Dyads provided context to the service members' narratives to allow a deeper understanding of their experiences. Service members completed a series of five Dyads to amplify their narratives. Each Dyad is comprised of a specific prompt based on a theme and two signifiers on a dyadic scale (see Appendix F, Ten Dyad Themes, Prompts, and Signifiers). Service members positioned a dot along the dyadic scale that linked the relationship between the two signifiers and their narrative. If no relationship existed, then service members selected the "N/A" option (see Figure 6). Dyads allowed the service members the ability to reinforce certain ideas and experiences within their narrative.[63]

[63] Introducing SenseMaker®."

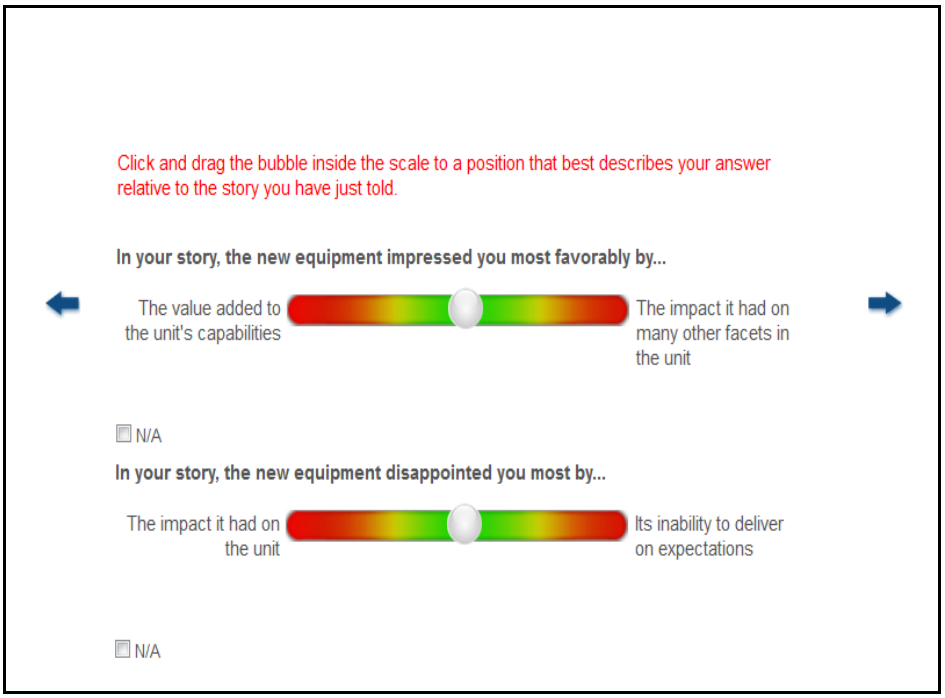

Figure 6. Examples of SenseMaker Collector Dyads based on the theme of "Impressed" and "Disappointed" with the prompts "The new equipment impressed you most favorably by" and "The new equipment disappointed you most by," respectively

Upon completion of the collection instrument, the aggregated data was analyzed using the SenseMaker Explorer software program, which provides eight functions to analyze the data on two levels, pattern and narrative analyses.[64] The cluster and distribute functions (see Figure 7) assist in identifying areas of interest or concern based on the disposition of service member narratives depicted as dots in the Triads (see Figure 8) and histogram bars in the Dyads (see Figure 9). We then extract individual or groups of narratives from the areas of interest and read them to gain information and further insights through the lens of different themes. This software program allows us to analyze the data that "adds layers of meaning" rather than simply read the narratives at the surface level.[65]

[64] SenseMaker® Explorer's eight functions to analyze the data are glance, browse, compare, range, distribute, cluster, graph, and landscape. "SenseMaker Explorer: Distribute and Cluster," video clip, YouTube, 2010, http://vimeo.com/16278489.

[65] Cognitive Edge Pte Ltd., "SenseMaker®," 2013, http://www.sensemaker-suite.com/smsite/index.gsp.

Figure 7. SenseMaker Explorer's eight analysis functions

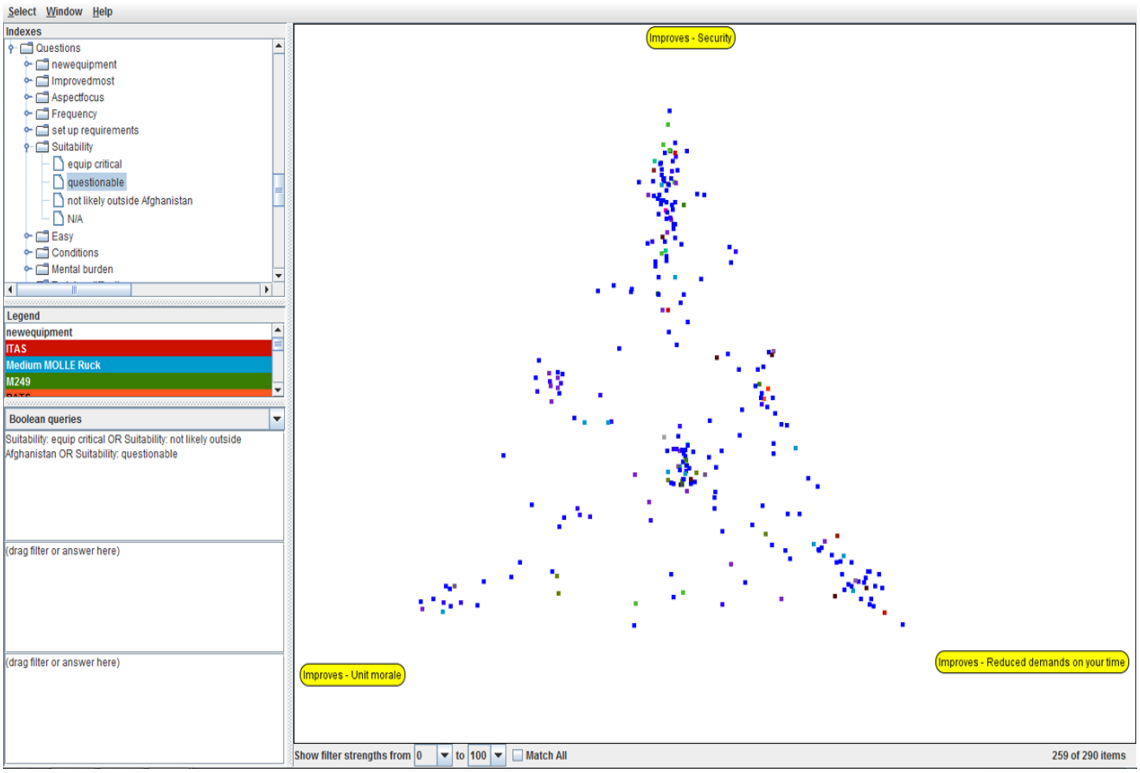

Figure 8. The Triad is an example of SenseMaker Explorer's cluster function output based on the theme of "Improve." Each dot represents individual service member narratives.

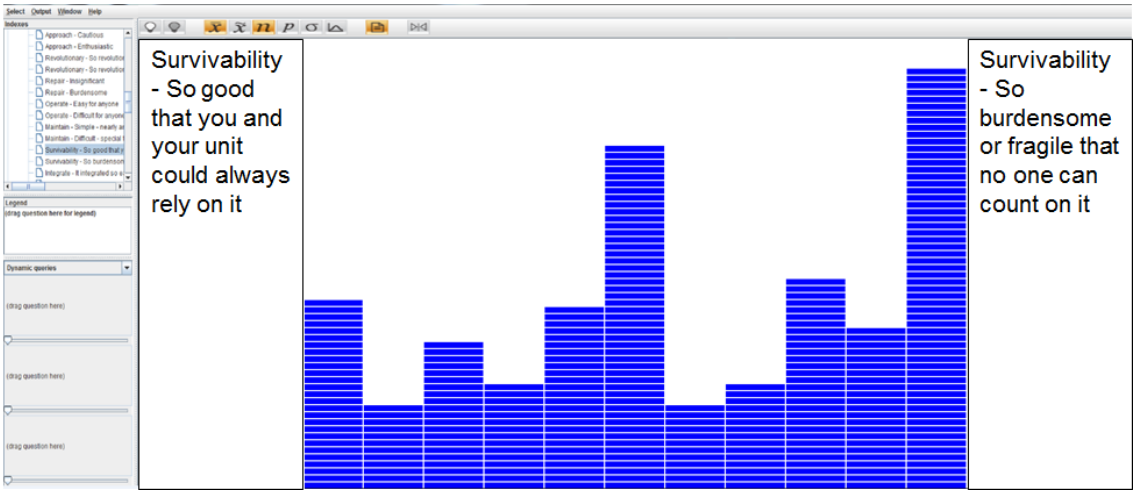

Figure 9. The histogram above is an example of SenseMaker Explorer's distribute function output based on the theme of "Survivability." Each bar within the histogram represents individual narratives.

SenseMaker Suite's Collector and Explorer provide the ability to collect and analyze quantitative and qualitative data. The themes used during the research could amplify service member narratives by providing context and a deeper understanding of the information presented. In the following chapter, the data is analyzed using Sensemaking Explorer to determine if sensemaking of narratives can inform the Army CDP.

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V. RESULTS

This chapter analyzes a dataset comprised of 279 service member narratives and associated responses to signifying questions using the SENSI model to make sense of these narratives to gain information. We organized the narratives into two groups for analysis, 1) the collective group comprised of all narratives, and 2) a subset focused on the GBOSS.[66] We analyze the narratives on two levels. The first level uses Triads and Dyads to analyze patterns created by service member significations (or amplifications) of their narratives in response to a specific prompt associated with a theme. Pattern analysis allows us to identify specific areas of interests for further investigation. The second level, narrative analysis, offers additional layers of meaning and understanding of service member experiences with equipment. Narrative analysis was not automatic. We did not use a semantic analysis package. Instead, it was necessary to read and understand participants' stories in addition to the analysis SenseMaker might provide. Participants' stories spanned a broad-spectrum of operational system and equipment use. As demonstrated in the analysis that follows, those narratives are quite informative regardless of sample size or spectrum.

A. COLLECTIVE GROUP ANALYSIS

This section analyzes 279 narratives representing 90 different pieces of equipment (see Appendix G, Equipment List According to Primary Functions of Shoot, Move, Communicate, and Survive According to Field Manual 7-21.13, *The Soldier's Guide*) using the Triad theme "Failed to Improve" and Dyad theme "Implement and Operate." Figures 10 through 13 display the summary results of service member input and signification in response to narrative interview prompts.

[66] All equipment in the research can be categorized into one of four combat tasks: shoot, move, communicate, and survive, according to Field Manual 7-21.13, The Soldier's Guide. Headquarters Department of the Army, "FM 7–21.13 The Soldier's Guide," *Headquarters Department of the Army*, February 2004, http://armypubs.army.mil/doctrine/DR_pubs/dr_a/pdf/fm7_21x13.pdf.

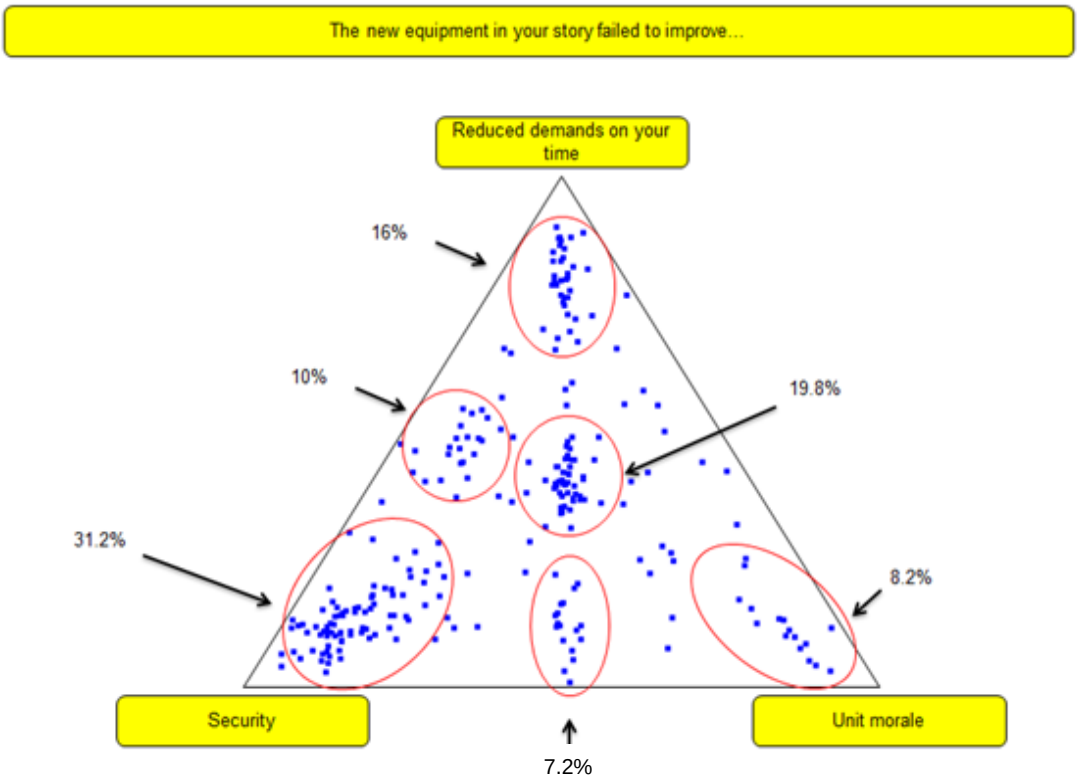

Figure 10. This Triad is based on the theme "Failed to Improve" and shows six concentrated areas of service member narratives. Each blue dot corresponds to service member assessments of the equipment described in the narrative as it relates to the Triad prompt and the meanings associated with the triangle's vertices.

Figure 10 depicts an example of the information produced by SenseMaker Explorer, by capturing service member signification of their narratives to the theme "Failed to Improve" by responding to the prompt: "The new equipment in their story failed to improve…" Data displayed in Figure 10 reflect responses from 279 service members illustrating how the equipment that they described in their narratives fit the prompt. Due to the diverse spectrum of operational equipment and a large volume of service members' signification of their narratives, the resulting dataset in the Triad might be expected to be spread equally among the three signifiers (security, unit morale, and reducing the demand on you time) on the vertices. However, our analysis of Figure 10 suggests that the significations of narratives are associated more with security, reduced demands on your time, or both, rather than unit morale. More interestingly, further

investigation showed that the heaviest concentration (31.2%) of representative responses was associated with the signifier, "security." This piqued our interests, which required focusing on this area. Using the second context of the SENSI model to analyze narratives, we gained insight into why warfighters assessed that fielded equipment failed to improve security in Figure 11.

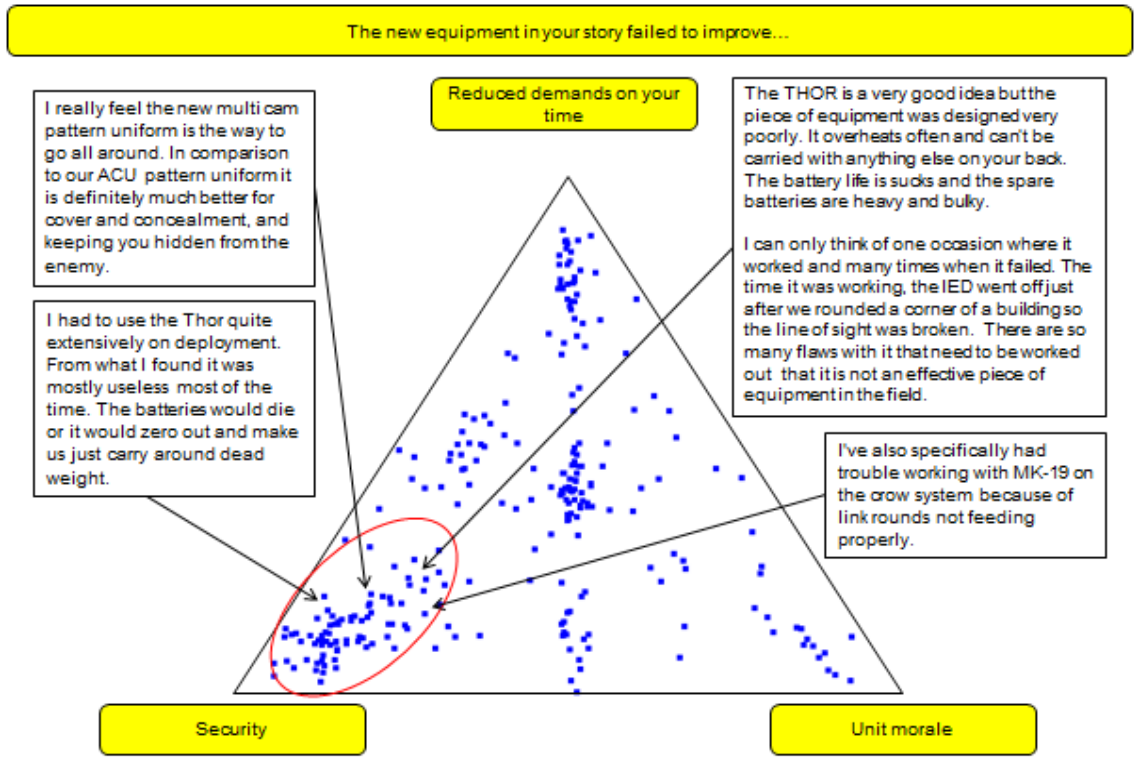

Figure 11. SenseMaker Explorer output from Figure 10, but now with service member narratives associated only with signifier "security."

Figure 11 depicts the identical information as Figure 10, but now with selected service member narratives identified with their associated concentration and the signifier, "security." Participants' commentaries convey that equipment failed to improve security for two reasons, 1) a lack of training, and 2) its inability to perform claimed capabilities. Service members said that equipment failed to improve security because of a lack in training on the system and the inability to troubleshoot the system. For example, several service members operating the Common Remotely Operated Weapon (CROW) system stated that they "had trouble working with the Mark-19 (40 mm grenade launcher) on the

system because of link rounds not feeding properly." It is interesting that this narrative identifies at least two possible reasons why the equipment failed to improve security. First, the service member could have failed to receive proper training on loading and troubleshooting the weapon system. Second, the weapon system or its munitions could have experienced a technical problem. Analysis of additional narratives within the concentration in Figure 11, using the SENSI model, provides more insight and greater detail to why equipment failed to improve security than simply the pattern analysis.

Representative responses displayed in Figure 11 stated that the ACU and the THOR III Man Portable Counter Radio Controlled Improvised Explosive Device Countermeasure System failed to perform claimed capabilities of the fielded equipment. Participants stated that the ACU pattern did not improve their security because it failed to adequately provide concealment compared to the multi-camouflage pattern. In comparison, the multi-camouflage pattern was effective in "keeping you hidden from the enemy." The ACU pattern did not increase service members' survivability or improve their security level against enemy combatants in a desert or woodland terrain.

In addition, the THOR III failed to improve security, which resulted in service members losing confidence in the system. For example, subjects stated that they could "only think of one occasion where it worked and many times when it failed." We learned that the THOR III is a good piece of equipment in concept but poorly designed because "it overheats often and can't be carried with anything else on your back." The narratives provide insight into why equipment deficiencies failed to improve security.

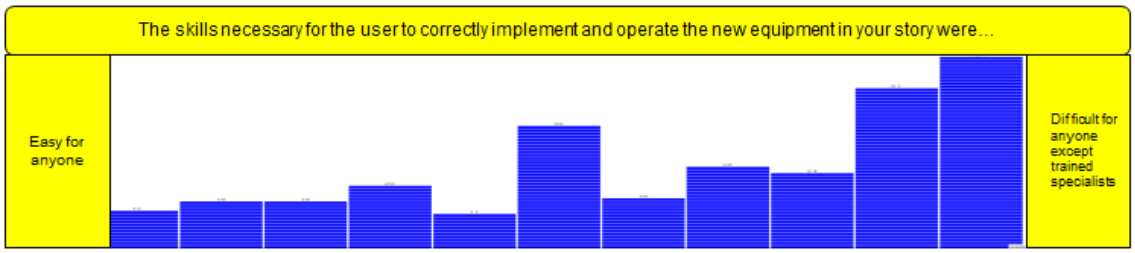

Figure 12. This Dyad is based on the theme "Implement and Operate," and signification of associated narratives in this histogram is skewed to the right showing a stronger association with "difficult for anyone except trained specialists."

Next, in Figure 12, the SenseMaker's distribute function is used to analyze a Dyad, which is associated to the theme "Implement and Operate." Figure 12 illustrates the signification of representative responses to the prompt "The skills necessary for the user to correctly implement and operate the new equipment in your story were…" The pattern in Figure 12 demonstrates that their responses were skewed significantly toward the difficult (right) end of the response spectrum. Generally, the equipment fielded to the participants appeared to be difficult to implement and operate.

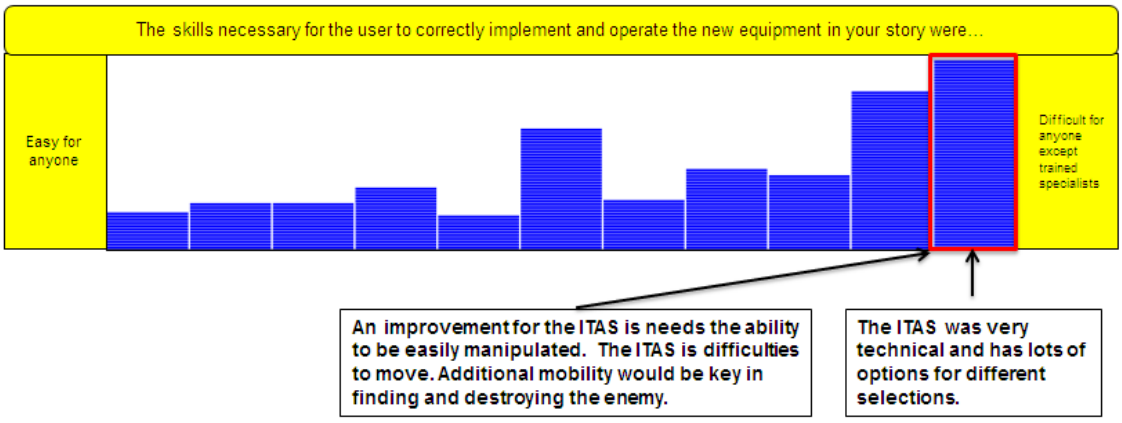

Figure 13. Portions of narratives associated with the Dyad in Figure 12 amplify service members' significations to the theme "Implement and Operate."

During our analysis of narratives associated with the histogram, the SENSI model assisted us in interpreting why the equipment was difficult to implement and operate. Information drawn from the narratives identifies that equipment end-users could implement and operate the equipment but only at the rudimentary level because of lack of training associated with technical aspects of the equipment. For example, service members stated that the Improved Target Acquisition System (ITAS) was capable of operating at a higher proficiency, but they lacked the required training. They stated, "I was unable to effectively use it, I believe with additional training, I would be able to compensate for the shortcoming." Furthermore, additional narratives displayed in Figure 13 state that service members used trial and error to compensate for their lack of training and knowledge of the ITAS. Interestingly, further analysis of narratives makes it possible

to understand that the ITAS's computer-based operating system was too complex. Moreover, the narratives specified that the equipment was "very technical and has lots of options for different selections…the system was not very user friendly." Overall, we learned that respondents prefer more intuitive equipment to implement and operate.

Significations/amplification of narratives in Figures 10 and 12 combined with associated narrative fragments in Figures 11 and 13 provide valuable insights that can inform the equipment development and fielding process. Our analysis of narratives in Figures 10 and 11 conveyed that service members were primarily concerned about their security and the acceptance of the equipment based on its performance. Figures 12 and 13 show that an ill-conceived computer-based operating system and a lack of training were not optimal for warfighters to implement and operate. Narratives associated with concentrated patterns in both Figures 11 and 13 indicated that if the obstacles associated with training, performance, and technical aspects of the equipment could be overcome prior to fielding, then they could be better received by service members.

Given a diverse collection of equipment and a large volume of service members' signification of their narratives, Army General Staff, specifically the G3/5/7, could use the information derived from service member narratives to define and validate equipment requirements in the form of DOTMLPF. This information could assist in overcoming previously identified obstacles from Figures 11 and 12. Also, the Army G3/5/7 could provide guidance and directives to address issues within the CDP to improve future development of equipment. The information derived from a diverse collection of equipment offers insight to PMs and equipment developers but is limited because the information is generalized. However, using the SENSI model to analyze narratives associated with a single piece of equipment might provide more detailed information that could inform PMs and equipment developers for potential future success of equipment development and fielding. We will apply this process to make sense of service member narratives associated with the GBOSS/Cerberus/CMMS.

B. GBOSS/CERBERUS ANALYSIS

This section analyzes 11 narratives representing a specific piece of equipment, the GBOSS—a fielded system from a family of equipment that has been assessed at every TSOA/WTTM event. Although we were only able to analyze a small sample size of participants who had worked with the GBOSS, the results proved insightful. Our initial findings applying the SENSI model indicate that narratives provide feedback that is very similar to commentaries from the ART/TSOA WTTM Assessment and HTA feedback. We gained this insight by analyzing narratives associated with the GBOSS using the Triad themes "Benefit Provided" and "Aspects to Improve." We expanded our research by examining stories linked to the Dyad themes "Maintaining Equipment," and "New Equipment Integration." This information could help PMs and equipment developers better understand the GBOSS and its shortcomings. In addition, this information could lend insight into the WTTM process.

The GBOSS, also known as Cerberus or CMMS, is a force protection system that provides the ability to detect, track, display, record, and transmit video.[67] Specifically, the GBOSS offers two sensors, a motion detection radar and a day/night camera system. The radar provides a 360-degree field of view with a range of two kilometers. The camera system has a thermal capability for limited visibility and night use, as well as a day vision camera. The system provides persistent surveillance using radar to enhance the ability to detect moving targets.[68] The GBOSS can be operated in two configurations, trailer-mounted as shown in Figure 14 and man-portable pack shown in Figure 15. In the following narratives, the participants' experiences with the GBOSS are examined to gain insight into the development and fielding of the system.

[67] William D. Midgette, "Enhancing the Operational Effectiveness of the Ground-Based Operational Surveillance System (G-BOSS)" (master's thesis, Naval Postgraduate School, 2008), http://oai.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=ADA483482.

[68] U.S. Marine Corps, "Ground Based Operational Surveillance System," *Marines*, accessed April 17, 2014, http://www.pendleton.marines.mil/StaffAgencies/AssistantChiefofStaffG35/TrainingSupportDivision/TrainingDevices/GroundBasedOperationalSurveillanceSystem.aspx.

Figure 14. Trailer-mounted GBOSS system configured for operation[69]

[69] U.S. Marine Corps, "Ground Based Operational Surveillance System."

Figure 15. The system shown is a GBOSS Lite in the man-portable configuration[70]

[70] MTEQ, Inc., "MTEQ—Manufacturing Services Cerberus Lite," *MTEQ*, 2012, http://www.mteq.com/cgi-bin/dynamic.py?Page=manufacturingServicesCerberusLite.

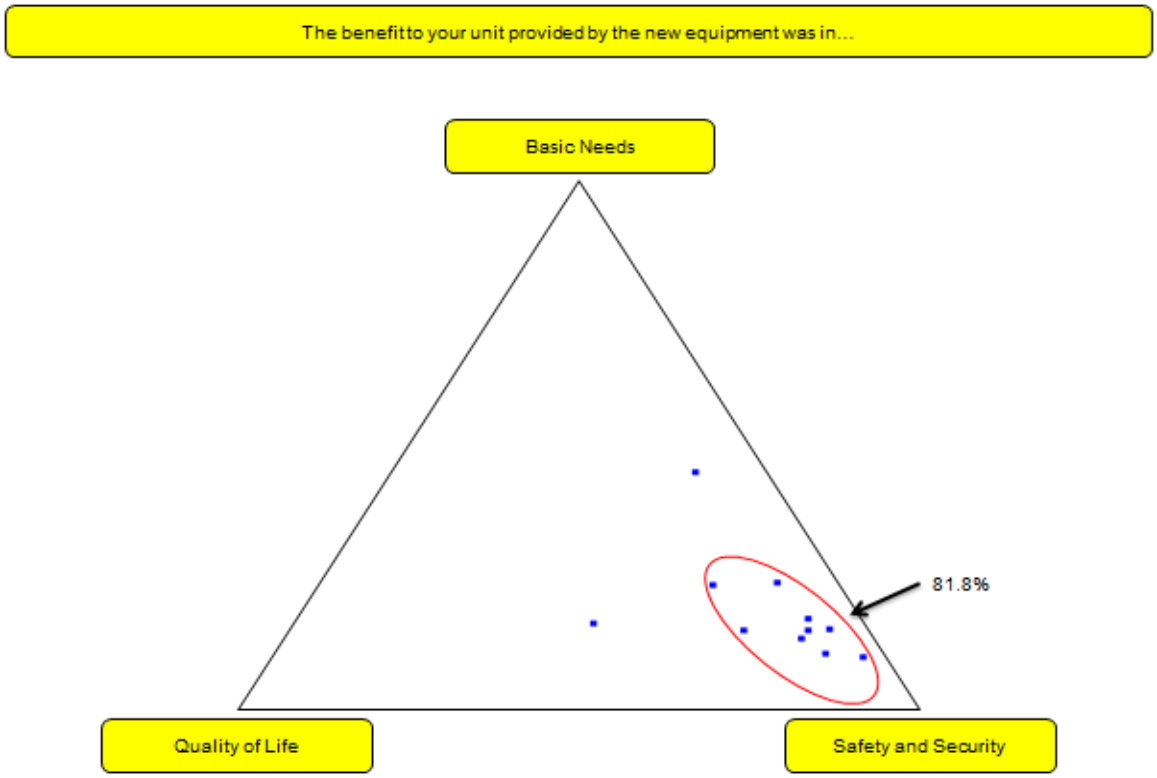

Figure 16. Signification of narratives to the prompt "The benefits to your unit provided by the new equipment was in…" Blue dots correspond with service member assessment of the GBOSS.

Figure 16 shows the resulting signification of narratives associated with the theme "Benefit Provided" that prompts service members to answer what "benefit the new equipment provided to their unit." The pattern represented in Figure 16 illustrates that all 11 respondents associated their narratives with the signifier," safety and security," even though two of these respondents also associated their narratives with the other vertices. The pattern prompted us to read and interpret all 11 stories to gain insight into why service members signified that the GBOSS benefited safety and security. Information gained from these 11 narratives shows that the GBOSS's technical capabilities increased the participants' safety and security. This finding is consistent with ART/TSOA WTTM Assessment and HTA assessments and commentaries, which is elaborated upon further in this section. However, the narratives might offer additional insights with equipment capabilities and performance, training, and fielding, which are explored further.

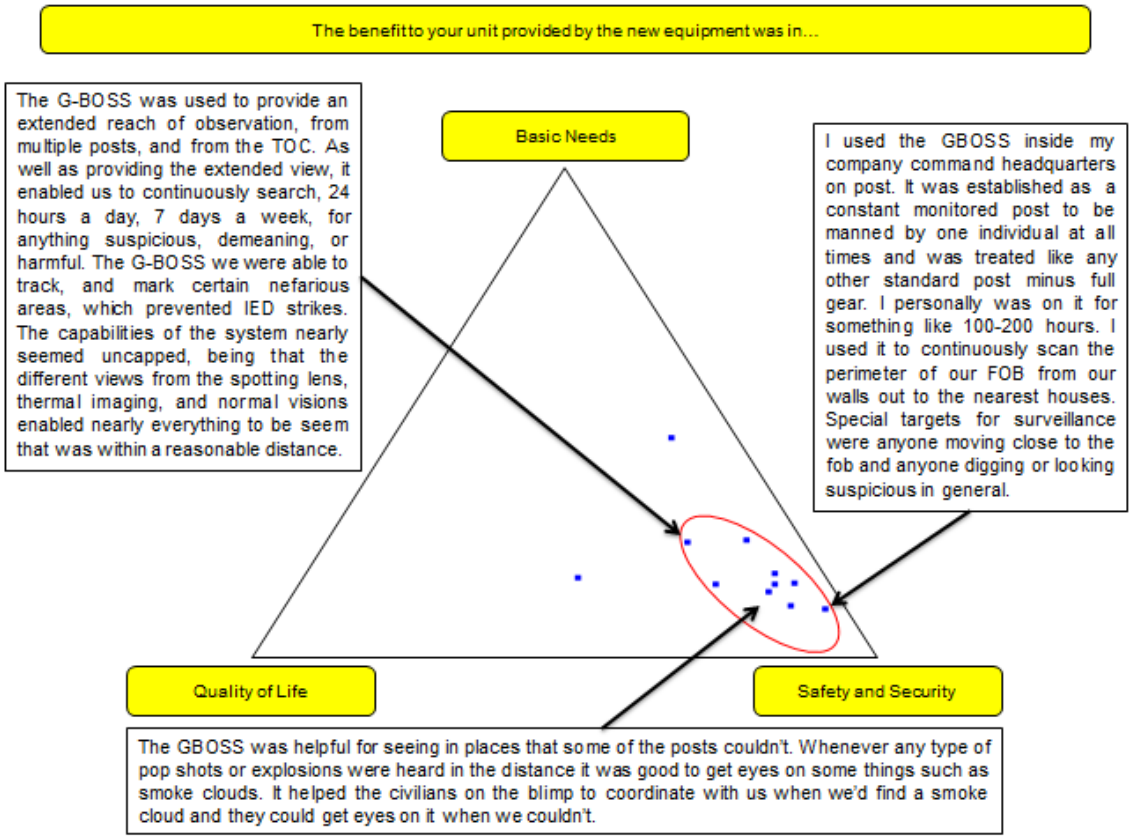

Figure 17. Participant signification and representative responses to the signifying prompts "The benefit to your unit provided by the new equipment was in…"

Figure 17 depicts representative responses that articulate how the GBOSS benefited service members' safety and security because of its technical capabilities. The GBOSS provided greater situational awareness around the operational environment through its enhanced visual monitoring capability. Participants stated that they could "look at situations that were happening in the surrounding area…see into the blind spots of the post…see in places that some of the posts couldn't." Additionally, service members stated that "the capabilities of the day and night cameras were exceptional" providing observation up to "three to four kilometers away." This information is comparable to ART/TSOA findings that confirm the warfighters' use of the GBOSS's visual monitoring capabilities but does not address the actual performance. For example, one ART/TSOA evaluator stated, "User is able to analyze, classify, and use all output products." The signification of narratives showed that the GBOSS, possibly its visual

monitoring capabilities, benefited their safety and security. More importantly, the first context of the SENSI model shows how narratives capture participants' experiences with the GBOSS to articulate how it benefited their safety and security along with shortcomings.

While providing feedback on the capabilities and performance of the GBOSS, narratives highlighted possible shortcomings of the system. End users stated that the GBOSS provided the ability to observe enemy targets and positions, but it failed to provide enemy grid locations accurately. For example, they stated, "The system in its current configuration will allow for general situational awareness, however is not capable of providing any precision target referencing or targeting in general…when actually operating the system, I noticed its lack of ability to give precise grid locations of potential targets I was observing." This feedback aligns with commentaries from the HTA, specifically "slew to cue…obtaining grid locations to targets was not obvious." However, these capabilities *do exist* within the GBOSS. The disparity between the feedbacks and the actual capabilities of the GBOSS raises an interesting question: "why did service members not know the complete capabilities of the GBOSS?" Further investigation into Figures 18 and 19 may possibly provide insights into whether the cause of the limitation was the equipment interface or a training issue or both (most likely).

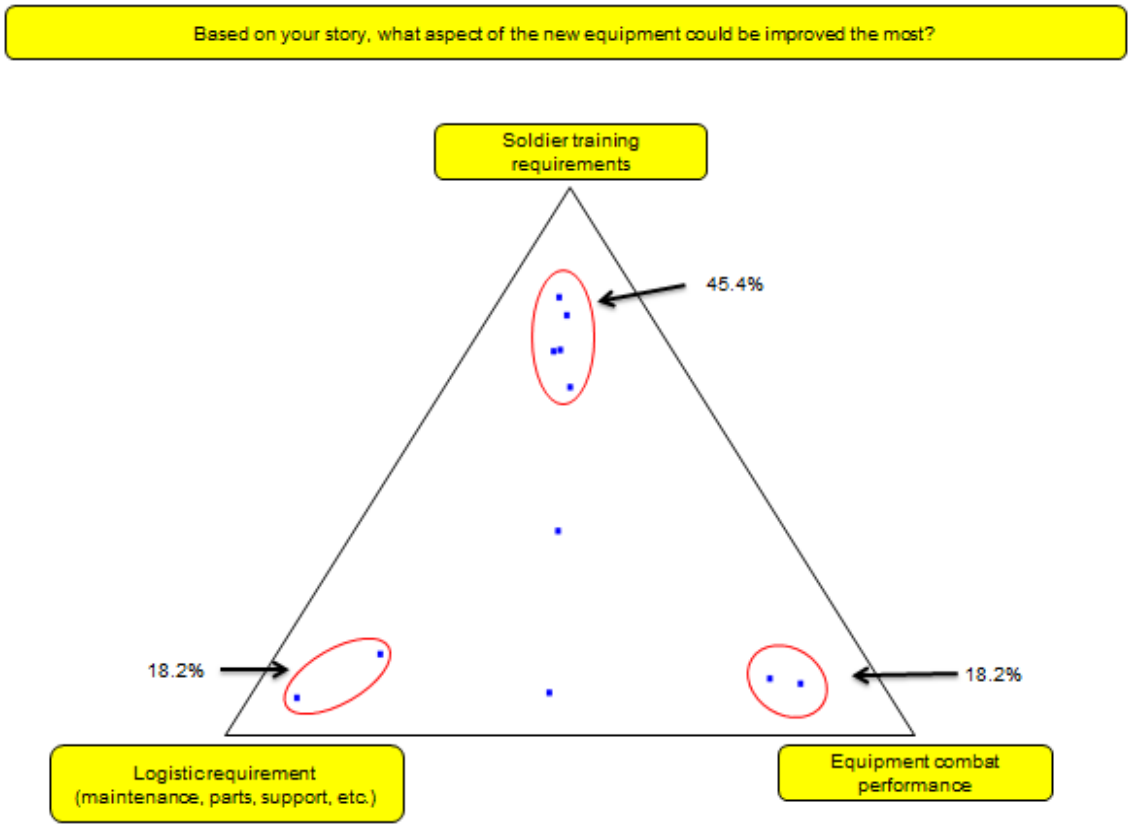

Figure 18. Signification of narratives to the prompt "What aspect of the new equipment could be improved the most…"

Figure 18 displays a Triad signification of service member narratives illustrating their association to the theme "Aspects to Improve" and prompts service members to answer "what aspect of the new equipment could be improved the most?" The resulting signification pattern shows that service member training requirements could be improved the most while the left and right ends are weighted equally. This pattern is consistent with our findings from Figure 17 identifying training as a possible issue with the GBOSS. The consistency in the two findings and WTTM feedback possibly offers an area of interest for further consideration to understand how soldier-training requirements could be improved the most. In addition, we found it intriguing that the left and right vertices were weighted equally, which prompted further analysis. Once again, information gained from stories and ART/TSOA WTTM Assessment and HTA commentaries remain similar. For example ART/TSOA evaluator commentary states "there is (sic) certainly more than 5 steps to access primary functionality of the system and requires insights that are beyond

the average Soldier," which is consistent with our analysis of narratives associated with Figure 19.

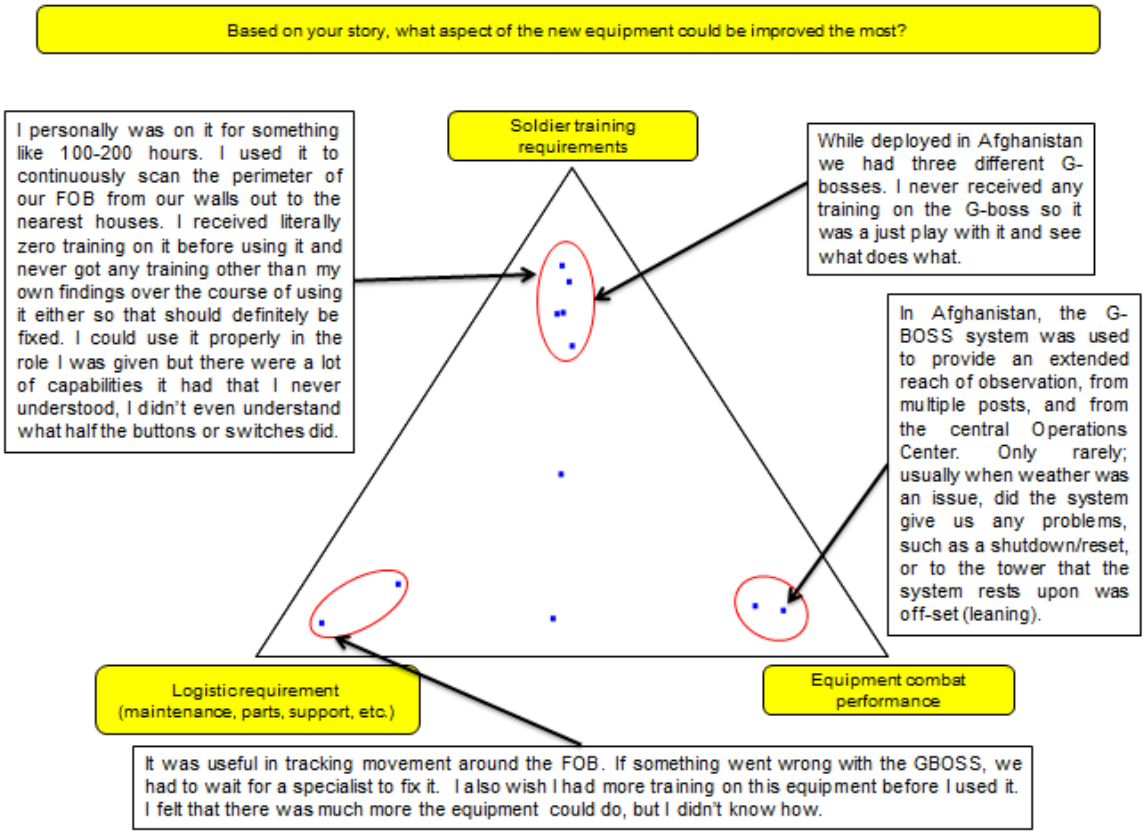

Figure 19. Participant signification and representative responses to the signifying prompt "What aspect of the new equipment can be improved the most?" Participants' narratives convey that training requirements is the most important aspect to improve.

Information gained from Figure 19 identifies that the participants did not receive any formal training on the GBOSS, but rather, they gained experience through repetitive equipment use during their deployment. A subject stated, "I received literally zero training on it before using it and never got any training other than my own findings over the course of using it." Additionally, another subject noted, "I never received any training on the GBOSS so it was a just play with it and see what does what." Although they were able to employ the equipment, the lack of training prevented them from operating the GBOSS to its full potential. This deficiency highlights a possible problem with the Relief

in Place/Transfer of Authority (RIP/TOA) process, in which service members may not receive training on equipment transferred between units. One interesting fact of the WTTM HTA process is that it has untrained soldiers perform basic functions and operations on the GBOSS during ART/TSOA events. This situation is a parallel endeavor to the RIP/TOA process; in other words, soldiers in the field receive no handover time with equipment that they inherit after relieving a unit. More importantly, service members stated that "there were a lot of capabilities it (GBOSS) had that (they) never understood," as well as that they "didn't even understand what half the buttons or switches did." These narratives provided insights that users employed the GBOSS to less than its full potential because they lacked formal equipment training or because the GBOSS user interface was so burdensome as to preclude discovery of the system's full potential.

The ART/TSOA evaluator commentaries indicated that formal training is required to use the GBOSS to its full potential, similar to our findings. Moreover, HTA commentaries specified, "the system assembly was not an issue for trained service members but proved difficult for those untrained due to a high number of components." Also, ART/TSOA WTTM Assessment feedback stated that "equipment performance hinged on service member's operational training on the GBOSS because the system interface was not intuitive and required too many steps." Interestingly, the comment referencing system interface is also found in our narrative analysis.

Interpretation of our data revealed that the GBOSS interface was an equipment shortcoming for warfighters because "the system was not very user friendly; with each additional menu that was opened, that window would dock on within the viewing panel and reduce the usable screen space." Comparable to the narratives, HTA commentaries conveyed, "the GBOSS's operational screen was not intuitive to service members when operating the system," and "the interface was not similar to any currently fielded surveillance systems. One of the soldiers in the WTTM HTA field exercise and assessment suggested that it might be beneficial to have the interface share common

features, appearances, functionalities with Blue Force Tracker's."[71] Should the PM and equipment developer have an interest in this information, these narratives and commentaries could inform them that the interface is too difficult to operate without proper training, which could negatively affect combat performance. This explanation suggests that a more intuitive interface has the potential to increase service members' ability to understand and operate the equipment; thereby, possibly increasing combat performance even with a lack of formal training.

While the results from this analysis of the top vertices from Figures 18 and 19 provide valuable information, it may be possible to gain additional information by analyzing the narratives associated with the left and right vertices of these Triads. Examination of narratives associated to the signifier, "equipment combat performance" and WTTM assessments and commentaries showed that the GBOSS performed sub-optimally under unfavorable conditions. Our analysis of narratives suggests that the GBOSS had problems "when weather was an issue" and "continuously froze or was blurry." In the case of ART/TSOA WTTM Assessment, commentary addresses that the GBOSS underperformed in certain unfavorable external conditions (e.g., excessive vibrations and shocks). It was learned through both analyses that, 1) equipment assessment might benefit from testing in adverse weather conditions, and 2) PMs and equipment developers may consider improving the design of the GBOSS to withstand unfavorable external conditions.

Interpretation of both the narratives associated to the signifier, "logistic requirement" and WTTM assessments and commentaries showed that the GBOSS maintenance requirement placed added burden on service members and their units which led to the question of what kind of burden the participants experienced. Service member narrative commentaries suggest that when the GBOSS malfunctioned or became inoperable, they "had to wait for a specialist to fix it." Along the same line, WTTM assessment feedback stated the GBOSS "uses radars and camera systems that, if broken,

[71] Blue Force Tracking (BFT) provides situational awareness capabilities in products and systems that identify and track "friendly forces." General Dynamics C4 Systems, "Blue Force Tracking," *General Dynamics C4 Systems*, accessed April 4, 2014, http://www.gdc4s.com/blue-force-tracking.html?taxonomyCat=132.

could cause significant delay in getting the system back operational. This could take weeks unless the technology is shipped with additional sensory equipment." Also, "over the course of the TSOA, the CMMS (GBOSS) had several software malfunctions that required a SME (Subject Matter Expert) to remedy." It might be concluded that a participant's inability to fix the GBOSS and the time required to repair the system limited its use and reliability, which placed a significant burden on the unit. However, commentaries also suggested that issues occurred within the development and fielding processes, such as, 1) lack of training for end users on maintaining the GBOSS, 2) limited number of trained specialists to support the system, or 3) the units may possibly lack adequate tools to repair the deficiencies. Surprisingly, the current HTA (see Appendix C, Example of Hierarchical Task Assessment for Centurion Multi-Mission System (CMMS)) employed at ART/TSOA events does not assess the end user's ability to troubleshoot and repair system deficiencies. We suggest that WTTM incorporate troubleshooting and repair as tasks when assessing soldiers working with new equipment at TSOA events.

Overall, the insights gained from the Triad in Figures 16–19 and their associated narratives could prove useful to the development and fielding processes by identifying potential capability and technological gaps that might have been overlooked, as well as providing solutions to fill these gaps. We now turn to an investigation of the Dyads (Figures 20–23) associated with the GBOSS to gain additional insights into improving the overall development and fielding processes.

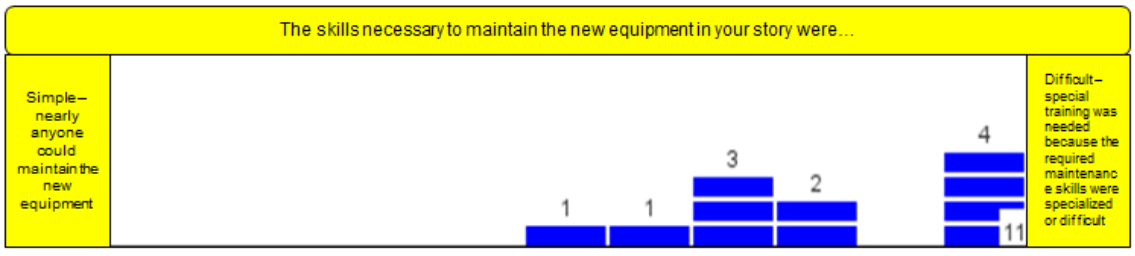

Figure 20. Dyad results from participants' significations of narratives regarding "The skills necessary to maintain the new equipment…" Histogram depicts that special training was needed to maintain the GBOSS.

Figure 20 summarizes service members' significations of their narratives in response to the prompt: "the skills necessary to maintain the new equipment were…" associated with the theme "Maintaining Equipment." The pattern in this histogram clearly illustrates that the GBOSS is difficult to maintain because it required special training. Furthermore, this data appears to be consistent with and possibly validates both our results from Figure 19 and WTTM assessment feedback gained through TSOA events.

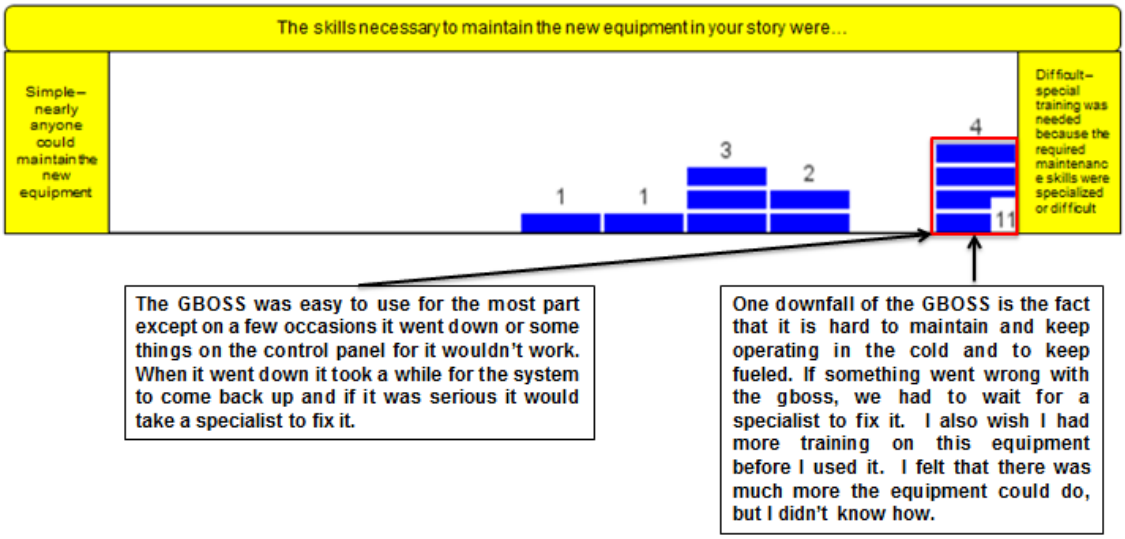

Figure 21. Portions of narratives associated with the Dyad in Figure 20 amplify participants' significations to the theme "Maintaining Equipment."

Figure 21 conveys portions of narratives that support our previous findings in Figure 19, specifically, the narratives associated with the signifier, "logistic requirements." Our analysis of narrative segments associated with the Dyad in Figure 21 states, "when it (GBOSS) went down it took a while for the system to come back up and if it was serious it would take a specialist to fix it," and the "downfalls of the GBOSS was the fact that it was hard to maintain and keep operating in the cold." These narrative fragments reiterate that service members experienced shortcomings with the GBOSS that they were unable to correct without a trained specialist. These fragments also confirm the WTTM assessment commentary, which stressed the same logistics concern. Although our

analysis of the Dyad did not provide additional insights into maintaining the GBOSS, it did reinforce previous findings that could improve the system.

Last, we analyze the manner in which the GBOSS might integrate with other combat systems and the operational environment. This analysis produces useful information that could enhance the CDP and WTTM assessment process. Figure 22 depicts subjects' signification of their stories associated to the theme "New Equipment Integration" and prompts a response from them regarding "how easy was it for you and your unit to integrate the GBOSS with other combat systems and the operational environment?" As illustrated in Figure 22, the signification demonstrates that service members had a mixed assessment of the GBOSS's integration with other combat systems and the operational environment. However, further examination of their responses displayed in Figure 23 suggests that the GBOSS actually integrated easily with the operational environment and other combat systems, which added value to their unit. Our conclusion mostly aligns with observations from WTTM assessments, particularly, GBOSS integration with other combat systems.

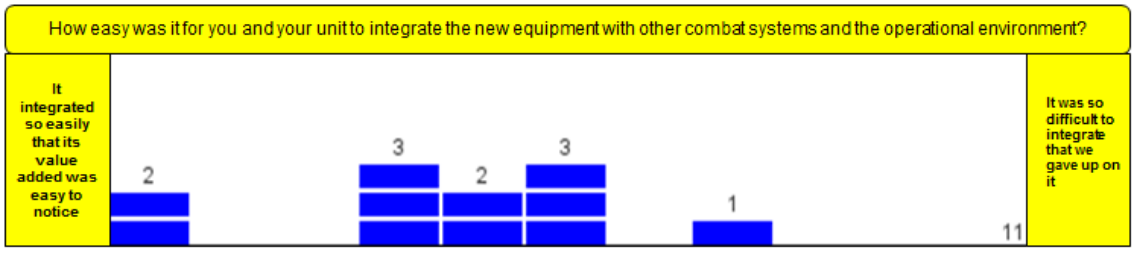

Figure 22. Dyad results from subjects' significations of narratives regarding GBOSS integration with other combat systems and the operational environment.

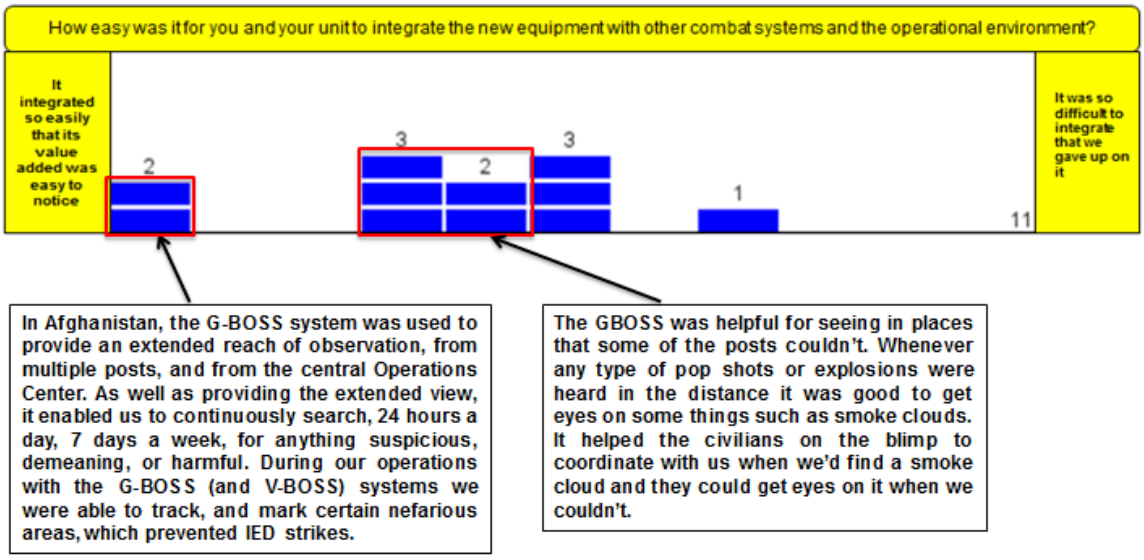

Figure 23. Portions of narratives associated with the Dyad in Figure 22 amplify subjects' significations to the theme "Equipment Integration."

Service members expressed that they were able to integrate the equipment quickly into the operational environment to enhance their situational awareness. For example, they stated that the GBOSS "provided an extended reach of observation," which allowed the service members to "continuously scan the perimeter of the FOB (Forward Operating Base) from the walls out to the nearest house." Also, the stories articulated that the GBOSS provided the ability "to track and mark certain nefarious areas, which prevented IED (Improvised Explosive Devices) strikes." The narratives indicated that the increased safety and security added from equipment integration within their operational environment was easy to notice.

Additionally, narratives showed that units were integrating the GBOSS with other base security and observation equipment in complementary roles. A participant's story identified that the GBOSS easily integrated with another force protection and observation system (an observation blimp) in Afghanistan. A warfighter stated that the GBOSS "helped the civilians on the blimp to coordinate with us when we'd find a smoke cloud and they could get eyes on it when we couldn't."

Similar representative responses mirrored some of the results from WTTM assessments and commentaries concerning equipment integration. For instance, a TSOA evaluator's commentary identified that the GBOSS "would be integrated in the unit's Operation Center by the FSR (Field Service Representative) upon initial setup." As well, feedback from the ART/TSOA WTTM Assessment discussed that once the integration between the systems was established, the GBOSS performed without issues.

Comparison of narratives and WTTM commentaries also shows that narratives may fail to capture important information about the GBOSS, specifically addressing its assembly. Our analysis of collected narratives did not address system assembly of the GBOSS because the research subjects fell in on already assembled systems. However, the WTTM HTA did gain feedback on the GBOSS assembly, which annotated the complexity of the task for untrained users. Specifically, the HTA commentary described how end users were confused with the layout of the cables and were unable to reference any "Quick" assembly diagrams. Further commentary from the ART/TSOA WTTM Assessment explained, "once trained on the system, soldiers will have no difficulties setting up the system." We learned that WTTM feedback mechanisms are capturing insightful information that can assist in the future development and fielding of the GBOSS. However, we also conclude that sensemaking of narratives, as described in the second context of the SENSI model, either as a stand-alone process or a complementary approach with existing mechanisms, can inform the CDP and assist WTTM in assessing equipment.

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VI. CONCLUSION

A. OVERALL FINDINGS

We determined that sensemaking of service member narratives associated with fielded systems and equipment provided valuable insights into performance expectations that can inform both the CDP and WTTM. We obtained stories from 279 participants through interviews in accordance with IRB protocol to create a database of narratives and signification. To analyze this data, we created the SENSI model that made it possible to study soldier narratives that they created from their experiences. By using this model, we analyzed soldiers' signified narratives through patterns, narratives, and narrative fragments to draw inferences regarding new equipment and the CDP. The SENSI model provided a novel approach to gain information about WTTM attributes and shortcomings (e.g., GBOSS performance in cold weather and having soldiers perform maintenance and troubleshooting tasks during TSOA events).

Applying this innovative process to gain insights about fielded equipment, we were able to identify benefits and shortcomings of narratives and sensemaking for such purposes. One benefit that narratives provide is firsthand accounts of end user experiences rather than second hand interpretations from a third party (e.g., evaluators, observers, etc.), which could contain biases. Moreover, the use of open-ended prompts to elicit these firsthand accounts can further decrease unintended biases that can result from a structured question format in traditional surveys. Furthermore, we found that open-ended prompts, Dyads, and Triads offered provocation that elicited emotive responses from end users about their experiences with equipment.

A benefit of sensemaking of narrative is that it offers a more in-depth approach for analyzing participants' experiences. When narratives are associated with a theme and signifiers, they provide a deeper and richer understanding than that accessible through traditional elicitation approaches, such as Likert-based surveys. Through sensemaking, researchers are able to gain insights and additional layers of meaning, which may have

been overlooked, discarded, or unidentified. This information could be used to overcome shortcomings of fielded equipment.

Although narrative analysis provides a beneficial approach to assessing equipment, two shortcomings may limit its potential application in the CDP and WTTM if not addressed. First, analyzing narratives is labor intensive because it requires human judgment to determine if the information presented in the narrative is relevant and has value. Although an automated approach to simulate human judgment does exist in the theory of Latent Semantic Analysis (LSA),[72] its application is limited. Researchers in the field of semantics state, "it is still impossible to perform SVD (singular value decomposition) on the hundreds-of-thousands-by-tens-of-millions matrices that would be needed to truly represent the sum of an adult's language exposure."[73] Simply, the ability to replicate human judgment and experiences required to understand narratives fully through automated means is inadequate.

Second, analyzing narratives is subjective and can result in conflicting interpretations based on researcher perspectives. Although it is nearly impossible to remove subjectivity associated with narrative analysis completely, it is possible to minimize it through, 1) an increased sample size of narratives, 2) multiple researchers must analyze narratives, or 3) collect and analyze supporting quantitative (statistical) data associated with equipment (e.g., completion time of specific task, success/failure rate of performance, etc.). Researchers should apply these recommendations to minimize incongruent interpretations. If these shortcoming are not properly addressed, PMs and equipment developers risk not capturing or analyzing the rich data within the narratives to inform the development and fielding process.

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[72] Latent Semantic Analysis (LSA) is a mathematical/statistical technique for extracting and representing the similarity of meaning of words and passages by analysis of large bodies of text. Laham, Darrell, "LSA website Executive Summary," *Latent Semantic Analysis @ CU Boulder*, accessed April 10, 2014, http://lsa.colorado.edu/.

[73] Thomas K. Landauer, Peter W. Foltz, and Darrell Laham, "An Introduction to Latent Semantic Analysis," *Discourse Processes* 25, no. 2–3 (1998): 259–84.Singular Value Decomposition (SVD) is a general form of factor analysis to condense a very large matrix of word-by-context data into a much smaller, but still large-typically 100–500 dimensional-representation.

B. SPECIFIC RECOMMENDATIONS TO CDP AND WTTM

The CDP has been effective in producing equipment for warfighters; however, this process still contains faults that contribute to developing and fielding poorly designed equipment (e.g., ACU, CROW, THOR III, ITAS, and GBOSS) as identified in the previous chapter. A recommendation to help the CDP mitigate the production of flawed equipment to soldiers is applying sensemaking of narratives as a feedback mechanism. Collection and analysis of narratives could be implemented during two separate steps of Phase 4 of the CDP, 1) initial manufacturing, and 2) preliminary equipment fielding. During the initial manufacturing step, a small sample size of equipment is produced for operational testing, which is the first time when warfighters are able to use the equipment in non-scripted but controlled scenarios and provide feedback. The PMs can collect and analyze warfighter narratives as an operational testing feedback mechanism to gain their first hand experiences with equipment performance. Information gained could assist in initial modifications and adjustments prior to the preliminary fielding of equipment.

During preliminary fielding, a small baseline of equipment is issued to select units for additional testing in a training or combat environment. In contrast to the previous testing, this step allows for warfighters to use the equipment in uncontrolled environments and provide their narratives. More importantly, this step affords PMs and equipment developers an opportunity to collect and analyze soldier narratives based on their experiences in either combat or training conditions. Once again, information and insights drawn from soldier narratives could assist in modifications and adjustments before mass fielding.

Similarly, obtaining and analyzing narratives could be included during the ART/TSOA events. Following soldiers' testing of developmental equipment, TSOA evaluator can use open-ended prompts to elicit warfighter narratives associated with their experiences with the tested equipment. Obtaining and analyzing narratives can complement the WTTM ART/TSOA feedback mechanisms by providing additional insights.

C. EXTENSION OF NARRATIVES IN SPECIAL OPERATIONS AND GEOTAGGING

Conducting special operations involves more than just operational planning and intelligence analysis. In both Unconventional Warfare (UW) and Foreign Internal Defense (FID) operations, Army Special Operations Forces (ARSOF) soldiers must deal with various challenging issues, such as foreign cultures and values. It is possible that collecting and analyzing stories from indigenous populations could yield information about their culture and values that can be useful for soldiers during operations. Similarly, collecting and analyzing soldier narratives about their experiences and interactions with foreign cultures could also provide rich data and insights. Applying this idea, ARSOF commanders and intelligence specialists could use open-ended prompts about foreign cultures to collect soldier narratives during mission/operation debriefs. These narratives associated with relevant themes and signifiers (e.g., the population was friendly, neutral, or hostile) could be analyzed to provide useful information, especially the subtle cultural idiosyncrasies. Analysis of these stories can aid in simplifying complex problems associated with UW and FID operations, which can lead to a deeper understanding of foreign cultures and populations.

Obtaining and analyzing both native population and soldier narratives to gain information on cultures can be expanded even further through geotagging[74] to create an overlay as part of a geospatial knowledge repository. Warfighters can create narratives based on their interactions with locals and geotag them in a manner similar to Lighthouse,[75] a product developed by the Naval Postgraduate School's Common Operational Research Environment (CORE) Lab. As narratives would be collected about a specific culture and/or location, then aggregated and analyzed to possibly provide insights into the region's cultural geography. Additionally, sensemaking of these

[74] An electronic tag that assigns a geographical location to a photograph or video, a posting on a social media website, etc. Oxford Dictionary, "Geotag: Definition of Geotag in Oxford Dictionary (American English) (US)," *Oxford Dictionaries*, accessed May 9, 2014, http://www.oxforddictionaries.com/us/definition/american_english/geotag.

[75] Lighthouse is a program designed to collect socio-cultural data in the field and structure it for geospatial, temporal, or social network analysis. The Lighthouse Project, "About Lighthouse," *Lighthouse*, accessed May 9, 2014, http://lhproject.info/about-lighthouse/.

narratives' associated themes and signifiers can provide context, and amplify meanings of service members' and local population's experiences. Soldiers can access this geospatial knowledge repository to better understand the cultural environment of a region prior to their arrival.

The similar concept of applying geotags to text has been successfully used for various applications, such as, 1) using story maps as a means of organizing and presenting information,[76] 2) gathering information through crowd sourcing during the Haiti Earthquake crisis,[77] 3) using twitter to collect and share near real-time information about specific locations or events (e.g., Boston Marathon Bombers),[78] and 4) most commonly providing reviews about businesses (erestaurants, retail stores, etc.) on websites, such as Yelp, TripAdvisor, and Google. Although the concept of geotagging is not novel, the use of signified narratives in conjunction with geotagging to capture cultural geography is innovative.

[76] Story maps tell the story of a place, event, issue, trend, or pattern in a geographic context. They combine interactive maps with other rich content - text, photos, video, and audio - within user experiences that are basic and intuitive. Environmental Systems Research Institute, Inc., "What Is a Story Map? | Story Maps." http://storymaps.arcgis.com/en/articles/what-is-a-story-map/.

[77] Monica Hesse, "Crisis Mapping Brings Online Tool to Haitian Disaster Relief Effort," *The Washington Post*, January 16, 2010, sec. Print Edition, http://www.washingtonpost.com/wp-dyn/content/article/2010/01/15/AR2010011502650.html.

[78] Sharon Myrtle Paradesi, "Geotagging Tweets Using Their Content.," in *FLAIRS Conference*, 2011, http://www.aaai.org/ocs/index.php/FLAIRS/FLAIRS11/paper/viewFile/2617/3058.

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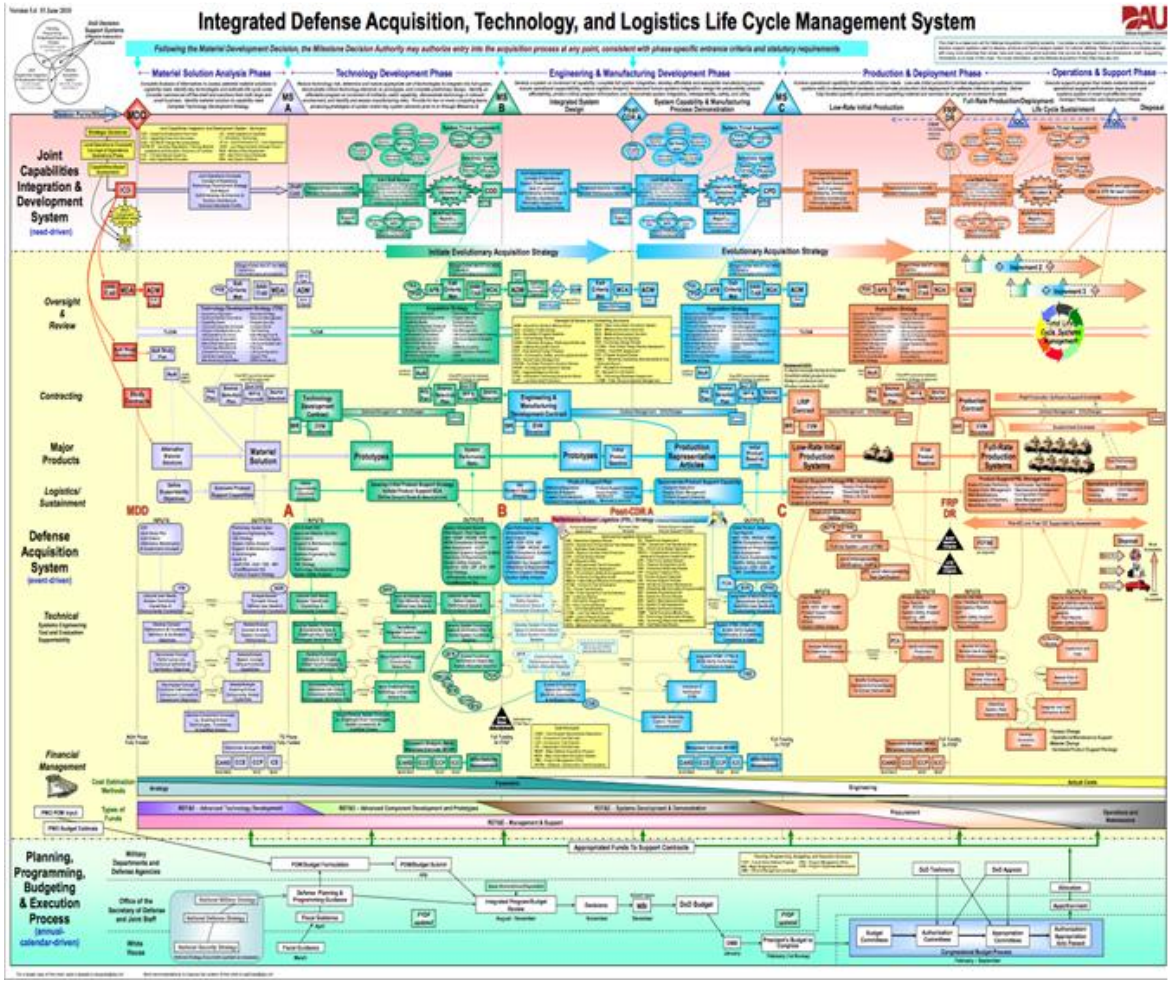
APPENDIX A. INTEGRATED DEFENSE ACQUISITION, TECHNOLOGY, AND LOGISTICS MANAGEMENT LIFE CYCLE



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APPENDIX B. EXAMPLE OF THE ART/TSOA ASSESSMENT TOOL (WTTM LOGISTIC FACTORS)

FOUO - ART TSOA SYSTEM ASSESSMENT PROTOCOL

WTTM Logistic Factors

Factor 1: Response to System Malfunctions (ICD-CB, IUBIP: C6 Non-Intrusive)

Required Location for Troubleshooting/Repair	Tools Required to Troubleshoot/Repair System	Skills Required to Troubleshoot/Repair System	Added Risk to Soldier Caused By Performing Troubleshooting/Repair	EL	ML	EH
Doesn't matter - system self-troubleshoots and repairs without network connection	None	None	None	10	10	10
Doesn't matter - system self-troubleshoots and repairs with network	None	Common soldier skills	Slight risk of minor injury	9	9	9
Doesn't matter - user can troubleshoot/repair without network connection/communications	Multiple tools available in unit	User can acquire with limited system use	Significant risk of minor injury	8	8	8
Doesn't matter - user can T/R with network connection/communications	Small number of tools available in unit	User can acquire with significant system use		7	7	7
On-site only without network connection/communications	Multiple tools supplied with system	User can acquire via soldier train-the-trainer	Slight risk of a major injury	6	6	6
On-site only with network connection/communications	Small number of tools supplied with system	Skills can be trained on in a short period of time by FSR		5	5	5
Must be done off-site at next higher unit's location	Multiple tools supplied with system	Skills available to unit only through significant training by FSR	Significant risk of a major injury	4	4	4
Off-site beyond next higher unit's location	Specialized tools available in Army logistic system	User can acquire only through significant training in CONUS		3	3	3
In-theater Contractor Support location	Specialized tools available only through commercial order	Skills acquired only through formal civilian education	Slight risk to life	2	2	2
Must be sent back to CONUS location	Specialized tools not available to unit	Must work for the system vendor to know how to troubleshoot & repair	Significant risk to life	1	1	1

Factor 2: Routine Preventative Maintenance (including software updates/upgrades) (IUBIP: C2 Persistent, C24 Sustainable)

Frequency	System Downtime	Skills Required for PM	Notes & Comments	EL	ML	EH
None required	0	None	This factor is only addressing pre-planned/known preventative maintenance.	10	10	10
None required during mission use at the Combat Outpost	less than 1 hour	Common soldier skills		9	9	9
	1 - 2 hours	Skills can be self-taught with limited system use		8	8	8
	2 - 4 hours	Skills can be self-taught with significant system use		7	7	7
Some amount required during a mission - no detrimental mission impact	4 - 6 hours	Skills acquired via soldier train-the-trainer		6	6	6
	6 - 12 hours	Skills can be trained on in a short period of time only by FSR		5	5	5
	12 - 24 hours	Skills can be trained on only through significant training by FSR		4	4	4
Significant amount required during mission - will degrade mission performance	1 - 2 days	Skills available to unit only through significant training in CONUS		3	3	3
	3 - 5 days	Skills can't effectively be trained, they can be acquired only through formal civilian education		2	2	2
	more than a week	Skills unique to vendor engineering group		1	1	1

Factor 3: Supply Support Planning Impact (ICD-CB)					
Consumables Required by System	**Impact on Planning**	**Notes & Comments**	**EL**	**ML**	**EH**
No consumables required by the system	No noticible impact to normal logistics planning	Examples of consumables are fuel, filters, oil.	10	10	10
All consumables are supplied in a normal LOGPAC ordered by COP	Minor advanced planning required		9	9	9
			8	8	8
			7	7	7
System requires consumables that add additional volume to routine LOGPAC levels	Typical advanced planning required		6	6	6
			5	5	5
			4	4	4
System requires consumables outside of the normal LOGPAC	Significant advanced planning required		3	3	3
			2	2	2
Unique consumable requirements not available in normal LOGPAC	Support requirements significantly stress normal logistics planning with unique requirements		1	1	1

Factor 4: Repair & Replacement Parts (ICD-CB)						
Number of Parts Requiring Repair or Replacement	**Potential Response Time for On-demand Repair Parts**	**Acquisition Process Required for Obtaining Parts**	**Notes & Comments**	**EL**	**ML**	**EH**
None	On-hand	System automatically orders and obtains parts prior to end user identifying need		10	10	10
Very small number	Less than 1 day	Normal unit infrastructure sufficient to obtain parts		9	9	9
		Additional unit resources needed to obtain parts		8	8	8
				7	7	7
Small number	1 to 3 days			6	6	6
	3 - 5 days			5	5	5
	5 - 7 days			4	4	4
Large number	1 -2 weeks			3	3	3
				2	2	2
	2 weeks or greater	Non-military, proprietary ordering with commercial shipping		1	1	1

Factor 5: Setup Requirements On-site (ICD-CB)						
Impact of Setup on COP Operations	**Tools and Equipment Required for Setup**	**Skills Required to Setup System**	**Notes & Comments**	**EL**	**ML**	**EH**
Setup process enhances COP operations and security	None required	None		10	10	10
None	Unit equipment sufficient for system setup	Common soldier skills		9	9	9
		Skills can be self-taught with limited system use		8	8	8
Setup inflicts minor degradation on COP operations		Skills can be self-taught with significant system use		7	7	7
Setup degrades COP operations	Non-unit equipment and tools needed	Skills acquired via soldier train-the-trainer		6	6	6
		Skills can be trained on in a short period of time only by FSR		5	5	5
		Skills can be trained on only through significant training by FSR		4	4	4
Setup negatively impacts COP security	Special, difficult to obtain tools and equipment needed	Skills available to unit only through significant training in CONUS		3	3	3
		Skills can't effectively be trained, they can be acquired only through formal civilian education		2	2	2
Requirements enhance enemy ability to engage COP		Skills unique to vendor engineering group		1	1	1

Factor 6: System Transportation Requirements (IUBIP: C5 Scalable)					
Transportation Impact on COP	**Imposed planning requirements**	**Notes & Comments**	**EL**	**ML**	**EH**
COP operations are enhanced by the presence of system transportation	No noticible impact to normal transportation planning	Requirements include handling, HAZMAT, and other non-standard transportation elements	10	10	10
None	Minor advanced planning required		9	9	9
			8	8	8
Presence of system transportation assets has a minor negative effect on COP operations			7	7	7
System transportation assets has a signficant negative impact on COP operations	Typical advanced planning required		6	6	6
			5	5	5
			4	4	4
Transportation assets has a significant negative impact on COP security	Significant advanced planning required		3	3	3
			2	2	2
Transportation assets has a positive effect on adversary's TTPs	Support requirements significantly stress normal transportation planning with unique requirements		1	1	1

APPENDIX C. EXAMPLE OF HIERARCHICAL TASK ASSESSMENT FOR CENTURION MULTI-MISSION SYSTEM (CMMS)

CMMS Hierarchical Task Analysis

The following pages contain the scenario used to assess hierarchical tasks on the Centurion System. We assessed two experts from Night Vision Labs on these tasks. Afterward, evaluator used 30 minutes to train two soldiers on the set-up and operation of the entire system, including the interface. Afterward, these two were subjected to the identical scenario as the two experts. After that, we took two complete novices and assessed their performance on the scenario.

Set up and make operational the trailer-mounted system

1. Set up local security and make operational the C2 back pack system.

Operate the Centurion System

A. Identify Targets Using the Ranger R3D Radar

1. Ensure the Radar is Active and is in Doppler Short Mode
    a. Locate the R3D Radar (STS-1400) menu in the tree view (left side of the screen displaying all of the sensors available to each system) and ensure the colored rectangle next to it does not have a down arrow next to it.
    b. Select the R3D Radar (STS 1400) sensor form view in the tree view by left clicking on the word "R3D Radar"
    c. Locate the Properties button on the simple form view (simple form view appears to the right of the map once "R3D Radar (STS-1400)" is selected)
    d. Select the Properties button in the R3D Radar (STS-1400) simple form view by left clicking on the button Properties
    e. Locate the Mode drop down menu in the R3D Radar (STS-1400) "Properties" window and ensure it is in Active mode. If not, open the drop down menu and select Active.
    f. Locate the Doppler heading at the lower left corner of the "Properties" window and ensure the Scan Mode is set to Doppler. If not, open the drop down menu and select Doppler.
    g. In the Time On Target Drop Down menu below the Scan Mode, ensure the selection is on Short.

h. Locate the OK button at the bottom of the "Properties" menu

i. Select the OK button to close out of the R3D Radar (STS-1400) "Properties" window and to accept any changes made to the R3D Radar modes.

B. Classify the Radar Target (Vehicle? Personnel?)

2. Open C16 Video window by clicking on the C16 Video level (beneath C16 Imaging Suite level) in the tree view.

Double-click in the C16 Video window to make it "Active," which is indicated by a green border on the window.

Option 1: Through "Slew to Click" mode

a. Activate the "Slew to Click" mode by locating the "Slew to Click" icon (crosshairs) in the toolbar at the top of the screen or using the hotkey "CTRL+S"

b. Click on the "current" R3D radar hits, i.e., largest radar hits on the screen (dots on the map matching the color of the larger radar scan sector on the map) to slew camera to potential targets.

c. Identify current targets as vehicles with C16 video.

Option 2: Manually move C16 camera with gamepad joystick

d. Ensuring the C16 video window is green, move left bottom joystick on the gamepad joystick until the pink camera fans on the map are aligned with the potential radar hits on the map, adjust as necessary.

e. Identify targets as vehicles with C16 video.

C. Investigate the target using camera zoom

1. Press the up and down directional buttons on the upper left portion of the gamepad joystick to zoom in or out and assess vehicle targets with the C16 video.

a. Locate the grid coordinates of the target

2. Mouse over map

a. Identify the pink camera fans on the map to indicate where the cameras are looking

b. Once the camera fans line up with the radar targets of interest, mouse over the targets to obtain the grid coordinates, which are displayed at the bottom right of the screen

c. Pass target information (grid, description) to the TOC using software

Training Results:

Setup Type:	**Expertise`**	**Time (min:sec):**	**Evaluator Comments:**
Trailer	Expert		
Remote Security set-up	Expert		
Trailer	Trained by Expert		
Remote Security set-up	Trained by Expert		
Trailer	Novice		
Remote Security set-up	Novice		

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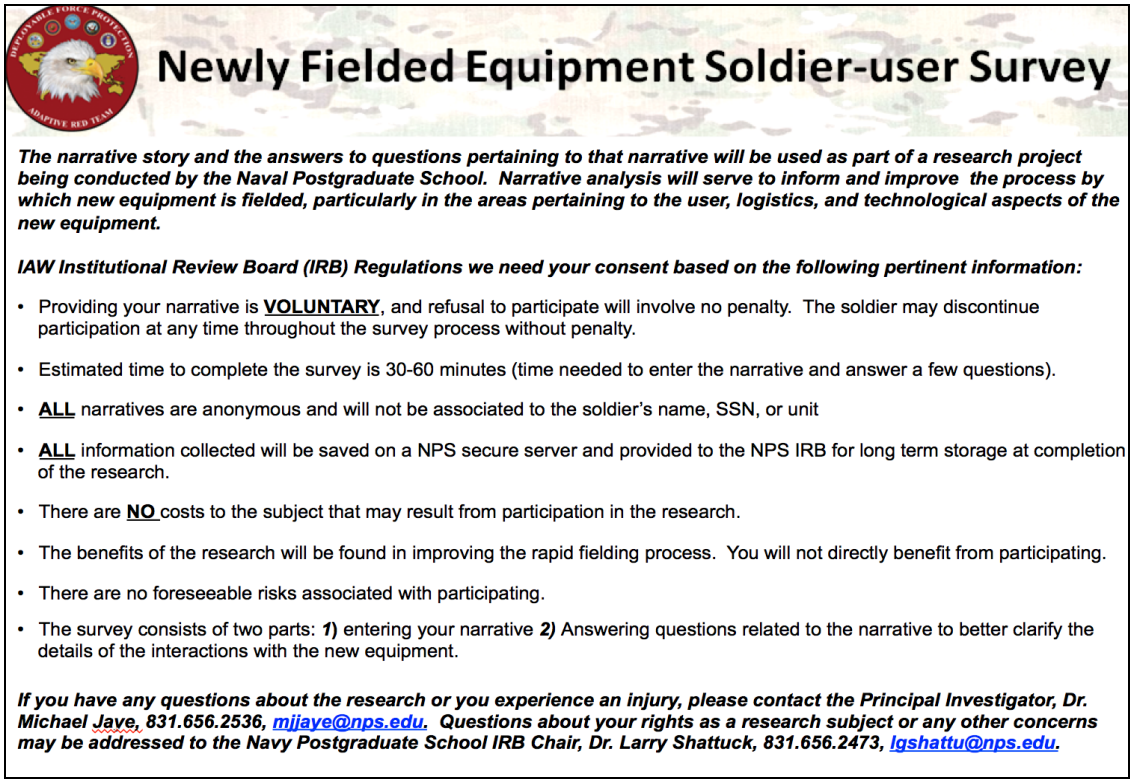
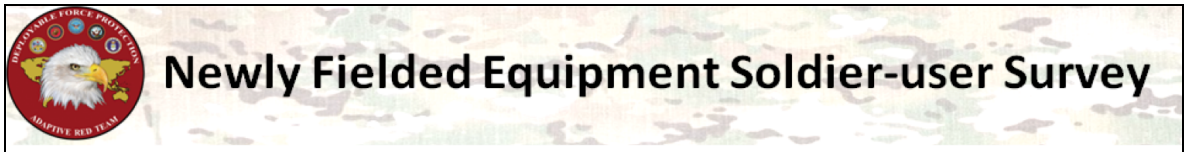
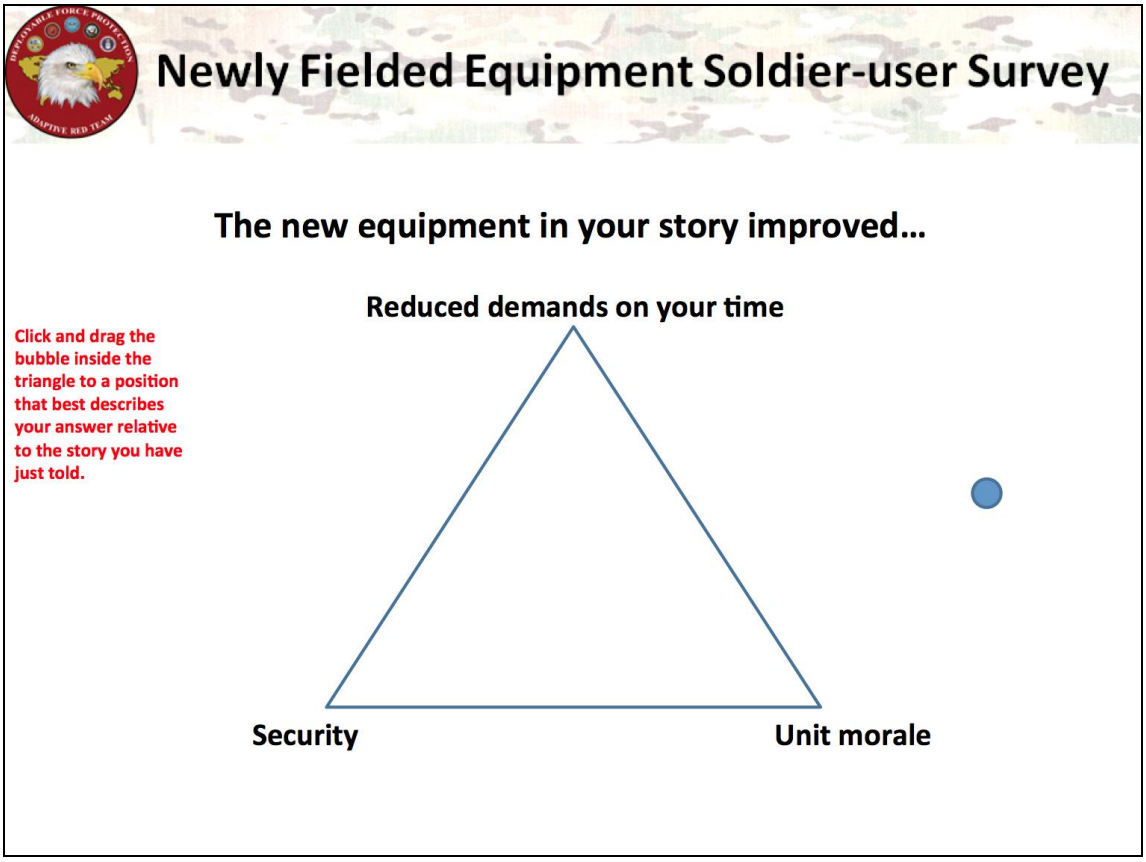
APPENDIX D. POWERPOINT COLLECTION TOOL ADMINISTERED TO GATHER SERVICE MEMBER NARRATIVES



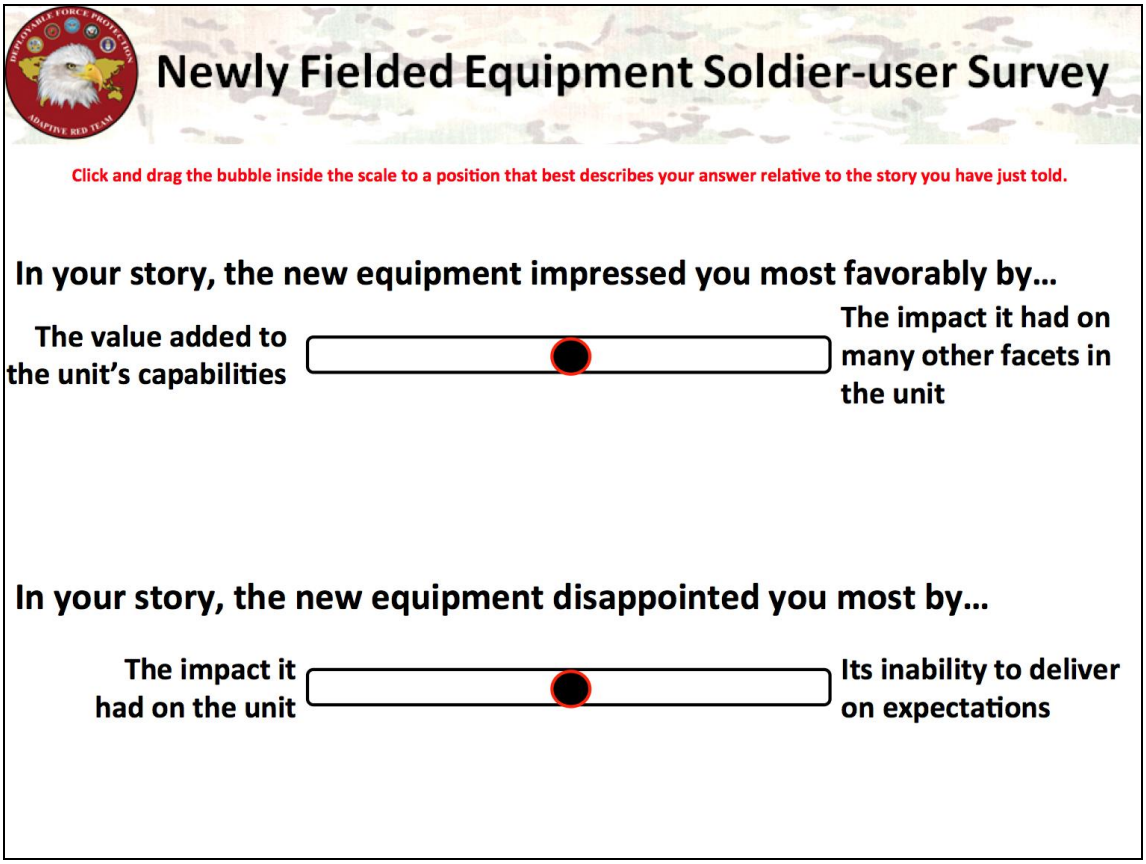
IRB



Narrative prompt



This is an example Triad with the theme "improved"



This is an example of two Dyads with the themes "impressed" and "disappointed" Multiple Choice questionnaire

APPENDIX E. EIGHT TRIAD THEMES, PROMPTS, AND SIGNIFIERS

Theme: Improved

Prompt: "The new equipment in your story *improved*…"

Signifiers: (a) Reduced demand on your time; (b) Security; or (c) Unit Morale

Theme: Failed

Prompt: "The new equipment in your story *failed* to improve…"

Signifiers:(a) Reduced demand on your time; (b) Security; or (c) Unit Morale

Theme: Benefit

Prompt: "The *benefit* to your unit provided by the new equipment was in…"

Signifiers: (a) Basic needs; (b) Quality of Life; (c) Safety and security

Theme: Harm

Prompt: "The *harm* to your unit caused by the new equipment was in…"

Signifiers: (a) Basic needs; (b) Quality of Life; (c) Safety and security

Theme: Aspects Improved

Prompt: "Based on your story, what aspect of the new equipment could be improved the most?"

Signifiers: (a) Soldier training requirements; (b) Logistic requirement (maintenance, parts, support, etc); (c) Equipment combat performance

Theme: Greatest Value

Prompt: "In your story, the new equipment's *greatest value* is found in…"

Signifiers: (a) Enhanced performance obtained by integrating with other systems; (b) The impact the new equipment had on the unit's combat capabilities; (c) The impact it had on logistical requirements (parts, maintenance, etc.) relative to capability gained

Theme: Greatest shortcomings

Prompt: "In your story, the new equipment's *greatest shortcoming* is found in…"

Signifiers: (a) Enhanced performance obtained by integrating with other systems; (b) The impact the new equipment had on the unit's combat capabilities; (c) The impact it had on logistical requirements (parts, maintenance, etc.) relative to capability gained

Theme: Attention

Prompt: "The situation I recalled in the story should get the *attention* of …"

Signifiers: (a) Congress; (b) The media; (c) The next unit that will field the equipment

APPENDIX F. TEN DYAD THEMES, PROMPTS, AND SIGNIFIERS

Theme: Impressed

Prompt: "In your story, the new equipment *impressed* you most favorably by…"

Signifiers: (a) The value added to the unit's capabilities; (b) The impact it had on many other facets in the unit

Theme: Disappointed

Prompt: "In your story, the new equipment *disappointed* you most by…"

Signifiers: (a) The impact it had on the unit; (b) Its inability to deliver on expectations

Theme: Approach

Prompt: "In your story, your *approach* to using the new equipment was…"

Signifiers: (a) Cautious; (b) Enthusiastic

Theme: Revolutionary

Prompt: "Based on the experience you've related, how *revolutionary* was the new equipment?"

Signifiers: (a) So revolutionary that it transformed the unit's capabilities; (b) So revolutionary that it was too hard to understand, use, or implement

Theme: Troubleshooting and Repairing

Prompt: "The effort you and your unit exerted in *troubleshooting and repairing* the new equipment was…"

Signifiers: (a) Insignificant; (b) Burdensome

Theme: Implement and Operate

Prompt: "The skills necessary for the user to correctly *implement and operate* the new equipment in your story were…"

Signifiers: (a) Easy for anyone; (b) Difficult for anyone except trained specialists

Theme: Maintain

Prompt: "The skills necessary to *maintain* the new equipment in your story were…

Signifiers: (a) Simple – nearly anyone could maintain the new equipment' (b) Difficult – special training was needed because the required maintenance skills were specialized or difficult

Theme: Operability and Survivability

Prompt: "The *operability and survivability* of the new equipment in your story were…"

Signifiers: (a) So good that you and the unit could always rely on it; (b) So burdensome or fragile that no one could count on it

Theme: Integrate

Prompt: "How easy was it for you and your unit to *integrate* the new equipment with other combat systems and the operational" environment?

Signifiers: (a) It integrated so easily that its value added was easy to notice; (b) It was so difficult to integrate that we gave up on it

Theme: Impact

Prompt: "The new equipment in your story had a significant *impact* on…"

Signifiers: (a) Logistic and maintenance demands; (b) Successful operations

APPENDIX G. EQUIPMENT LIST ACCORDING TO PRIMARY FUNCTION OF SHOOT, MOVE, COMMUNICATE, AND SURVIVE ACCORDING TO FIELD MANUAL 7-21.13, THE SOLDIER'S GUIDE

Shoot

Common Remotely Operated Weapon Station (CROW)

M320 Grenade Launcher Module

Mark VII Handheld Eyesafe Laser Rangefinder (MK 7E)

M240L Machine Gun

M249 Squad Automatic Weapon (SAW)

M2A1 .50 Caliber Machine Gun

MK 48 Machine Gun

PGM Mortar Round

Improved Target Acquisition System (ITAS)

M-4 Carbine

XM 2010 Enhanced Sniper Rifle

AN/PVS 6 Mini Eyesafe Laser Infrared (MELIOS)

Lightweight Handheld Mortar Ballistic Computer (LHMBC)

M240 Machine Gun Tripod

AN/PVQ 20 Dual Sensor Night Vision Goggle (DSNVG)

M-4 Carbine Free Floating Barrel

Mortar Fire Control System (MFCS)

Night Vision Goggles

AN/PEQ-15 Advanced Target Pointer Illuminator Aiming Laser (ATPIAL)

Stoner Rifle-25 (SR-25)

XM110 Semi-Automatic Sniper Rifle (SASS)

Move

Medium Tactical Vehicle (MATV)

RG-33 (Multi-purpose Mine-resistant Ambush protected Infantry Mobility Vehicle)

Light Medium Tactical Vehicle (LMTV)

Mine Resistant Ambush Protected (MRAP)

MaxxPro Recovery Vehicle (MRV)

RG 31 (Multi-purpose Mine-resistant Ambush protected Infantry Mobility Vehicle)

Remote Operating Tactical Vehicle

Double V-Hull Stryker

Communicate

Secure Electronic Enrollment Kit (SEEK II)

AN/PRC-117G Multiband Manpack Radio

RT-1523E Single Channel Ground and Airborne Radio System-Advanced System Improvement Program (ASIP)

Force XXI Battle Command Brigade and Below (FBCB2)

Soldier Worn Integrated Power Equipment System (SWIPES Kit)

Satellite Communication Radio (SATCOM)

Biometrics Automated Toolset System (BATS)

AN/PSN-13 Defense Advanced GPS Receiver (DAGR)

Distributed Tactical Communication System (DTCS)

LA-10u Handheld Laser Marker (HML)

Remote Operational Video Enhanced Receiver (ROVER)

AN/PYQ-10 Simple Key Loader (SKL)

Garmin Wrist Global Positioning System (GPS)

Survive

Medium Modular Lightweight Load-carrying Equipment - Ruck Sack (MOLLE)

Large Modular Lightweight Load-carrying Equipment - Ruck Sack (MOLLE)

Ground Bass Operational Surveillance System (GBOSS)

Centurion Multi-Mission System (CMMS)

Long Range Thermal Video Imaging System (LRTV)

M240L Machine Gun Barrel Bag

Alice Ruck Sack

Boots

Forward Repair System (FRS)

Air Items

Assault Kitchen

AMPS Generator

Computer Numerical Control Cutter (CNC)

Fueler

GP Medium Tent

M1120 HEMTT Load Handling System (LHS)

MEP 321A Generator

Automated Systems Scanner

Palletized Load System (PLS)

Standard Army Maintenance System-Enhanced (SAMS-E)

Standard Automotive Tool Set (SATS)

Plate Carrier

Multi-Cam Camouflage / CRYE

THOR III (Man-portable Counter Radio-Controlled Improvised Explosive Device and Electronic Warfare system)

Army Combat Uniform (ACU)

Improved Outer Tactical Vest (IOTV)

Advanced Combat Helmet (ACH)

CREW Duke (Counter Radio-controlled Electronic Warfare jamming system)

Wolfhound Handheld Threat Warning System

Boomerang 3 Shooter Detection System

Bradley Reactive Armor

M9 Aid Bag

Field Protect Mask (ProMask)

AN/PSS-14 Handheld Standoff Mine Detection System

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